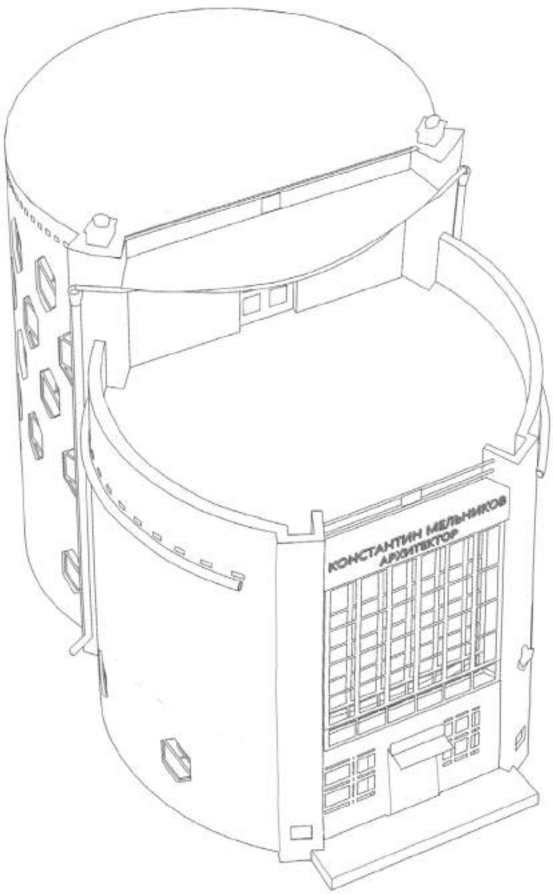
Melnikov House

Research Report and Recommendations for a Conservation Plan

10 Krivoarbatsky Lane,
Moscow, Russia

August 2019



The Getty Foundation

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Construction history

The Melnikov House in Moscow (1927 – 1929) has a most interesting history, which reveals a lot about Russia and its society.

With the generous support of the Getty Foundation through its Keeping It Modern initiative, the stages of historic and construction / technological research were implemented. PIK Group of Companies donation allowed to survey in detail geological and hydrogeological conditions of the site. During the research, 'Keeping It Modern' team had to thoroughly study the history of the house, build models of its structures, determine and undertake the least destructive places for the structural intervention.

From a historical point of view, the Melnikov House has many stories of different construction periods. Konstantin Melnikov (1890 – 1974) received his education during the time of the Russian Empire (until the October Revolution of 1917), therefore the architectural tradition of that time can be seen in many solutions of the architect and original structures of the building. Although prefabrication was the new codeword of the succeeding traditional Soviet residential architecture, the Melnikov House was built almost manually.

Since its construction in 1929 the house has undergone a number of changes, but it still remains a unique example of the almost untouched avant-garde architecture legacy of the 1920s. The damage to the House, occurred during the World War II as a result of the bombing in 1941, was restored in the late 1940s with limited economic and material resources. In the post-war period (1950 – 1980s) Soviet strategies in the field of materials and construction were mainly aimed at prefabricated structures, mass production, new efficient and industrial materials, as well as simple modern architecture and detail. This is also inherent in the Melnikov House as a consequence of fragmentary repairs and changes back to 1948-52, 1958, 1964 and 1976.

The restoration of the 1990s is of interest because carpentry and other traditional skills were used once again. In the 1990s, new post-Soviet materials, such as paints from Finland and other countries, were brought to the site. The stages and objectives of the research were good, but still the tools and methods of that time were not always optimal. A number of conservation issues were not solved and many works were of cosmetic character.

Research stages on site

Old written documents, drawings, photos, research and design materials from previous restoration projects and actual repair and restoration works helped to interpret the decisions made earlier.

One of the key challenges for the project team was to avoid harm to the original structures and authentic materials, that is to plan in advance how to obtain samples, examine structures, materials, colors etc. Detailed programs for geotechnical, structural engineering, materials and colors, heating and ventilation research were discussed and approved.

Geology, mycology (dirt and fungus), heating and utility network reports gave the knowledge and understanding of these specific fields for future considerations and possible actions.

Construction and building materials issues were approached from different perspectives. First, the structures were examined from inside and outside through the construction openings, then samples of building materials and colors were collected. The openings allowed us to learn about the conditions of construction, building traditions and difficulties of that time. For example, the floor joists, built into brick walls, suffered from cold and moisture most probably in 1940s. Moreover, the openings showed that even simple methods can be used when wooden structures must be strengthened.

The finishing materials and paint layers were surveyed in the best possible way by specialists from Dutch Cultural Heritage Agency.

Combination of the information, obtained in the course of all research stages, and the archival materials provided a comprehensive idea of the building condition, which will guide us to the next step, that is the actual conservation stage.

From Research to Conservation strategies

Time is the key

The more time spent at the site, the more possible it was to deepen into the history of the Melnikov House, to get the picture of the society and its people, technology, materials and methods, changes, everything. Therefore, it seems obvious that the Melnikov House should remain as intact as possible. Historical layers, stories and artifacts should not be touched during performance of only necessary conservation works.

Less is more

Research results and professional recommendations outline boundaries and provide directions for future action. All actions should be planned in such a way as to preserve the integrity of the house:

- The building envelope must be sound and restored in places of damage or structural problems
- Technical systems must be kept safe and functioning
- Monitoring systems must be installed to measure and inform of any changes in conditions
- Interior bearing structures (intermediate floors and walls) should be strengthened or changed only when needed and with solutions most considerate and delicate
- Interior plaster and paint works have to be considered very carefully, paint research report to be used as a guide
- Materiality, atmosphere and mood is totally essential and must be sustained
- The house and the site are united, site conditions and the general expression of the building era must be seen at the whole site

During the whole process we have faced first real joy when the Keeping It Modern project started, then pure and devoted enthusiasm and professional attitude to planning and implementation of different research stages. Research reports are thorough and impressive.

Our deepest thanks to all institutions, especially to all fellow professionals who gave their best knowledge and devotion to the iconic monument of the Russian avant-garde *'Dom Melnikova'* (The Melnikov House) and 'Keeping It Modern' project.

Pavel Kuznetsov, Project Leader
Tapani Mustonen, Chief International Expert
Tatyana Tsareva, Chief Local Expert

Key stakeholders of the project

The Getty Foundation fulfills the philanthropic mission of the Getty Trust by supporting individuals and institutions committed to advancing the greater understanding and preservation of the visual arts in Los Angeles and throughout the world. Through strategic grant initiatives, the Foundation strengthens art history as a global discipline, promotes the interdisciplinary practice of conservation, increases access to museum and archival collections, and develops current and future leaders in the visual arts. It carries out its work in collaboration with the other Getty Programs to ensure that they individually and collectively achieve maximum effect.

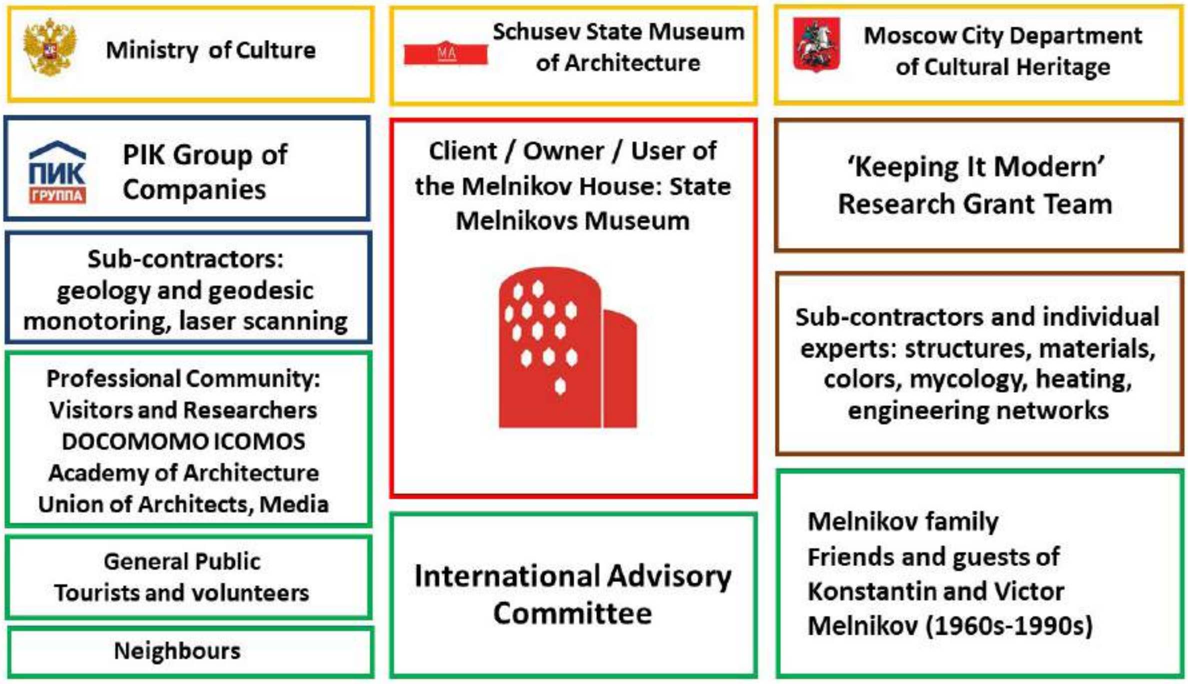
'Keeping It Modern' is an international grant initiative focused on the conservation of 20th century architecture worldwide. Launched by the Getty Foundation in 2014, Keeping It Modern grants support the creation of conservation management plans that guide longterm maintenance and conservation policies, the thorough investigation of building conditions, and the testing and analysis of modern materials. As a service to the field, technical reports from grant projects are made freely accessible online through the Keeping It Modern Report Library.

PIK Group of Companies is one of the largest Russian developers implementing comprehensive projects in ten regions of Russia with an emphasis on Moscow and the Moscow Region. PIK has been operating on the market since 1994 and specializes in the construction of comfort-class housing with all the necessary infrastructure. PIK is a long-standing partner of the State Melnikovs Museum in preserving the Melnikov House. President of the PIK Group Sergey Gordeyev donated his half-share in property rights on the Melnikov House to the Schusev State Museum of Architecture in 2010.

Schusev State Museum of Architecture was established as a national level museum under Russian Academy of Architecture in 1934. The museum keeps, researches and presents specific type of cultural heritage, a history of architectural ideas (projects) in various forms. The Museum collections include circa one million of exhibits (architectural drawings, models, fragments of architectural monuments, photos and negatives, applied art, sculpture, furniture, painting, archival documents, books, digital expositions) from XVIII to XXI century from Russia and Europe. The museum keeps the largest collection of Russian avant-garde architecture from 1910s – 1930s, including the unique archive of VKhUTEMAS art, design and architecture school (Russian analogue of Bauhaus school). The Museum is located in the centre of Moscow near the Kremlin, in the Talyzin estate, a complex of buildings of XVII – XIX centuries, which itself is 'an object on display', showing the history of Russian architecture.

The mission of the Museum is to make people happier through the acquaintance with masterpieces of architecture (both projects and actually constructed buildings) from various countries and epochs. The main objectives of the Museum are to be a centre of preservation of architectural heritage, to research it and present it to the public. The key public events include exhibitions in Russia and abroad, lectures and excursions on the history of architecture, special programs for children, publishing program, other non-exhibition events.

The State Museum of Konstatin and Viktor Melnikov was established by the Russian Ministry of Culture in February 2014 to fulfil the last will of Victor Melnikov (1914 – 2006), the son of the architect Konstantin Melnikov and the keeper of the Melnikov House in 1974 – 2006. The Melnikov House with all its memorial content and archives of Konstantin and Victor is a core of the State Melnikovs Museum, though the museum activities cover other buildings and projects by K. Melnikov. Among others it includes



Stakeholders of the Melnikov House conservation project

workers clubs, garages, exhibition pavilions and monuments designed and/or constructed in Moscow, Paris, Thessaloniki and other places.

The State Melnikovs Museum is on mission to discover the unique heritage of Konstantin and Victor Melnikov to the world. The main tasks are to save, research and present to the public Melnikov's works including the Melnikov House as well as to contribute to preservation of his other buildings. At the moment the activities of the State Melnikovs Museum include guided tours in the Melnikov House and bus tours for Melnikov's buildings in Moscow, inventory of Melnikov's archive, care-taking for the Melnikov House, preparation for conservation works in the House, public events such as lectures and open-air in the Melnikov House garden. The recently founded Museum is active on social media, it has established links with Russian and international museum community (ICOM Committee on Historical Houses, Iconic Houses Network).

IngStroyService-1 (ISS-1) company was established in 1996 by specialists from the Department of Dynamics and Strength of Building Structures, Moscow State University of Civil Engineering. Currently, it is a multidisciplinary engineering center with extensive experience in the technical examination of architectural monuments, preparing recommendations for their conservation. ISS-1 was chosen by the Museum of Architecture as the key contractor for the pre-conservation technical survey of the Melnikov House as it has rich experience dealing with Russian buildings of 1910s-1930s. It is crucial since the building materials and construction methods, used by Melnikov for his house project, are more of that 'old school' period in contrast to its vanguard architectural form.

Project Team

Project Leader Pavel Kuznetsov. Born 1971, researcher and lecturer in Soviet avant-garde architecture. Since 2010 deputy director of the Schusev State Museum of Architecture (Moscow, Russia).

In 2014 – 2016 he led the museumification of the Melnikov House, inventory of its memorial content and archive. As director of the State Museum of Konstantin and Viktor Melnikov (The State Melnikovs Museum) he opened the Melnikov House to the public in December 2014.

Author of the book 'The Melnikov House. Icon of the Avant-Garde, Family Home, Architecture Museum' (DOM Publishers, Berlin, 2017). Curator of the exhibitions: 'Melnikov Revealed' (2015, Melnikov House, Moscow), 'Melnikov / Le Corbusier: rencontre à la villa Savoye' (2017, Villa Savoye, Centre des Monuments Nationaux, France).

Chief International Expert Tapani Mustonen, born 1961 in Turku, Finland. Studied architecture at Tampere University of Technology. A large part of his works is concerned with the planning of alteration and repair of historically valuable architecture. His particular area of expertise is the restoration of modern architecture of 20th century.

His main work includes the restoration design of buildings drawn by Alvar Aalto such as the House of Culture, Aalto's own House at Riihitie 20, Villa Tammekann in Estonia, Seinäjoki City Library and the City Hall, Jyväskylä University Student Restaurant, and Viipuri Library in Vyborg Russia and others. He has participated in the Viipuri Library restoration project since its inception.

Apart from the design work Mustonen has been the advisory architect to the Alvar Aalto Foundation in 1995 – 1998. He is a Board Member of Pan European Cultural Heritage Organisation Europa Nostra and a member of the DoCoMoMo International Specialist Committee of Technology.

The restoration of Villa Tammekann received the Europa Nostra Award in 2002 and Viipuri Library restoration the World Monuments Fund / Knoll Modernism Prize in 2014. Tapani Mustonen was given the State Award for Architecture by Finnish Ministry of Education and Culture in 2014.

In pre-conservation survey of the Melnikov House he does scientific supervision of all research works, preparing program for the whole survey and its parts, and orchestrating work of ISS-1 experts and other experts.

Chief Local Expert Tatiana Tsareva, architect and historian of architecture. Graduated from Moscow Architectural Institute. She is an expert on state historical and cultural expertise (licensed by the RF Ministry of Culture), member of Federal Scientific and Methodological Council on Cultural Heritage under the RF Ministry of Culture, member of Union of Moscow Architects, member of Association of Art Historians, member of Expert Council of Russian Society for Preservation of Architecture and Culture Monuments.

Among her publications: 'New Housing. Architecture of Housing Complexes of Moscow in 1920s-1930s' (2012, Moscow, in co-authorship with E. Solovyova) and 'Districts of Volkhonka Street' (Saving Historical District of Moscow), 2014. She was a curator of the exhibition under the same title in the Schusev State Museum of Architecture (2014, Moscow). In pre-conservation survey of the Melnikov House she is a chief expert on documental and archival studies.

Project Team

Project Leader	Pavel Kuznetsov (Schusev State Museum of Architecture, Moscow, Russia)
Chief International Expert	Tapani Mustonen (Helsinki, Finland)
Chief Local Expert	Tatiana Tsareva (Moscow, Russia)
Key contractor for technical research	'IngStroySrevice-1' (Moscow, Russia)
Archival and documental research	Tatiana Tsareva with cartography prepared by Yulia Stepanova (Moscow, Russia)
Geological and geodetic survey	team led by Alexander Elisseyev (CISK company, Moscow, Russia)
Structural Engineering	Alexander Starchevsky, Dmitry Kuznetsov, Sergey Kashkin ('IngStroyService-1', Moscow, Russia)
Mycology	Elena Bogomolova, Irina Saneeva ('IngStroyService-1', Moscow, Russia)
Building materials and technologies	team led by Alexey Snedkov and Natalia Tankova ('Sirius' company, Moscow, Russia)
Paints and colours	Mariël Polman, Luc Megens (Dutch Cultural Heritage Agency, Amsterdam, the Netherlands)
Utility Networks	Andrey Senchenko ('IngStroyService-1', Moscow, Russia)
Electric wiring and installations	Andrey Kashirin ('WAYB' electric laboratory, Moscow, Russia)
Heating and ventilation	team led by Samvel Sargsyan (Moscow State Construction University, Moscow, Russia)
Translation	Denis Stroya (Schusev State Museum of Architecture, Moscow, Russia)
Designer	Elvira Khasanzanova (Schusev State Museum of Architecture, Moscow, Russia)

Meeting of the International Adisory Committee.
20 November 2017

International Advisory Committee

International Advisory Committee (IAC) was established for transparency of the pre-conservation survey process and further implementation of conservation works. It is chaired by Professor Jean-Louis Cohen (France). Other Committee members are Gines Garrido (Spain), Jörg Haspel (Germany), Holger de Kat (Netherlands), Vladimir Shukhov (Russia).

Chair of the International Advisory Committee
Prof. Jean-Louis Cohen (France), an architect and architectural historian specializing in modern architecture and urbanism in Germany, France, Italy, Russia and North America. He is Sheldon H. Solow Professor in the History of Architecture at New York University Institute of Fine Arts. The pioneering studies of Prof. Cohen became an obligatory reference source for any researcher of Soviet architecture. Among many others he is an author of 'The Future of Architecture. Since 1889' (London: Phaidon, 2012), 'Le Corbusier and the Mystique of the USSR, Theories and Projects for Moscow, 1928-1936' (Princeton: Princeton University Press, 1992) and co-author of Starr, S. Frederick 'K. Mel'nikov: Le Pavillon Soviétique – Paris, 1925' (Paris, 1985), a detailed study of groundbreaking Melnikov's project. Prof. Cohen is a member of the Cap Moderne Scientific Committee supervising restoration of the iconic Villa E1027 by Eileen Gray.

On November 20th, 2017 the State Museum of Konstantin and Viktor Melnikov hosted members of the IAC chaired by Prof. J.-L. Cohen in the Melnikov House. An all-day gathering of 30 experts in the Melnikov House was devoted to 'planning the plan'. Local and international experts discussed the philosophy, priorities, program, timing and organizational scheme of the pre-conservation survey of the Melnikov House and its adjacent site.

Research of structures, building materials and paints

"The house of Konstantin and Viktor Melnikov is an absolutely unique testimony to the Russian avant-garde, which has kept to this day both its integrity and its authenticity. Combining the expertise, acquired on comparable sites worldwide, will allow to save these qualities and implement a canonic preservation and maintenance project, which will have a wide impact beyond Russia".

Prof. Jean-Louis Cohen, Chair of the IAC

"The research program covers literally everything – from the foundations, construction, and inter-floor membrane to fabrics, colors, and built-in interior elements. Experts managed to find proper 'division of labor' among stakeholders of this complex project, with all participants recognizing the highest responsibility of their mission: to save this unique monument for humanity".

Pavel Kuznetsov, director of the State Museum of Konstantin and Viktor Melnikov

In the course of 2018 members of the IAC Jean-Louis Cohen, Holger de Kat, Vladimir Shukhov were paying visits to the House and were informed on a regular basis about the ongoing works during this period. The next general meeting of the IAC to discuss the results of the technical survey and recommendations for conservation plan will take place in December 2019 / January 2020 (the precise date to be confirmed).

Project objectives and results

1) The information basis for the implementation of conservation project should be provided. The result of research is a comprehensive scientific report on the current state of the House and the adjacent site.

Comprehensive technical survey should include analysis and tests of the structures (walls, roof, inter-floor membranes etc.) and of the historic fabric of the building (bricks, wood, metal, glass, painting and colors). Technical solutions for conservation works should be proposed both for solving issues of structural and engineering networks as well as for conservation of particular original elements of architecture and design.

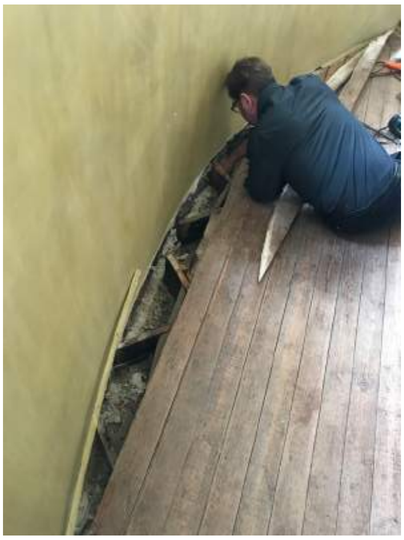
An important part of the project is an in-depth research of historical documentation and memorial content as together with other preliminary studies (visual survey, measured drawings) it will allow to compare the existent conditions with the original drawings and photos.

2) Necessary technical recommendations for conservation plan should be prepared in the course of the project, including short and medium-term conservation measures as well as a long-term care plan for preservation of the building with plans to increase the existing number of visitors from 2 000 per year up to 10 000 – 12 000 upon completion of conservation works.

3) The project should become a model for conservation planning to preserve other architectural monuments of the avant-garde heritage of 1920-1930s in Russia. It should serve as a key information source in the process of the Melnikov House nomination to the World Heritage List.

During October 2017 – June 2019 the pre-conservation research of the Melnikov House was completed and the following reports were issued:

- archival and documental research;
- geotechnical survey and geodetic monitoring;
- structural engineering;
- building materials and technologies;
- colors and paints;
- mycology;
- utility networks;
- electric installations and wiring;
- heating and ventilation.



Research of structures and building materials

All reports are compiled in Russian (except analysis of paint layers) and prepared in accordance with Russian preservation legislation in order to be valid for the following stages of conservation implementation works. This report is **a summary in English** of the mentioned above reports with some data, photos and drawings as examples and visualisation of the project results.

Full technical information, photos and graphics can be found in complete Russian versions of the respective reports.

Research of geological conditions, structures and building materials

Timeline of the project

June 2017	'Keeping It Modern' Getty Foundation grant award
Sept 2017	kick-off news conference
Oct 2017 – Nov 2018	documental and archival research
Nov 2017	International Advisory Committee meeting
Dec 2017 – May 2018	geotechnical survey and geodetic monitoring
Jan – Nov 2018	survey of the house itself (structures, materials, networks)
Nov 2018	presentation of the project results at St. Petersburg International Cultural Forum
Feb – June 2019	colors and paints research
July 2019	'Keeping It Modern' Getty grant completed
Dec 2019 – Jan 2020	International Advisory Committee meeting
Aug 2019 – Sept 2020	dissemination of results, compiling a dossier for inscription to the World Heritage List
2020	documentation for the conservation implementation project
2020 – 2023	conservation implementation works, conservation report and 'manual for the House'

Dissemination of the project results

The first article for the general public on the results of the project was published under the title 'Secrets of the House in Krivoarbatsky' by Pavel Kuznetsov in the issue of heritage preservation magazine *"Okhranyaetsya gosudarstvom"* ("Under state protection") in November 2018. Another announcement about the first results and findings of pre-conservation survey was made by Pavel Kuznetsov in the course of TASS news agency conference (October 10, 2018).

A detailed 90-minute long presentation of the project results was made by the Chief Experts and the Project Leader during St. Petersburg International Cultural Forum (November 16-17, 2018).

The other two presentations of the project and professional discussions of its results took place in ICOMOS Russian National Committee (February 28, 2019) and in Scientific Council of Moscow City Department of Cultural Heritage (April 22, 2019).

Upcoming presentations and discussions

Vladimir Shukhov, President of DOCOMOMO Russia and a member of the IAC will deliver the project results at the 7th International Scientific Conference «Modernism in Europe – modernism in Gdynia. 20th century architecture – preservation of its authenticity and integrity» (Gdynya, Poland, October 3-5, 2019).

A report on colors and paints research of the Melnikov House will be presented by Tapani Mustonen (Finland) and Mariël Polman (Netherlands) at the 16th International DOCOMOMO Conference (Tokyo, September 15-18, 2020).

International Advisory Committee meeting in December 2019/January 2020 (to be confirmed) will also be a part of a series of public discussions about future conservation implementation works.

All technical reports will be available to the public on the official site of the Schusev State Museum of Architecture www.muar.ru

Research of structures and building materials

Description of the site

History and significance of the building

The Melnikov House ('Experimental residential house and studio of the architect K.S. Melnikov') is a building designed by architect Konstantin Melnikov (1890 – 1974) in the center of Moscow for him and his family in 1927 – 1929.

The world-famous masterpiece of the architectural avant-garde, the house was built as 'an experimental cylindrical house' to test out Melnikov's very own concept of mass construction of residential estate. The original layout, elegant spatial arrangement and smart engineering techniques made this building famous all around the globe. According to Melnikov, the essence of the house lies in 'equivalence and equability of weights, light, air and heat'. The three main cylindrical rooms of the house are: a living room with rose 5 m high walls and one large 4x5 m window, a common bedroom, designed for the whole family and partitioned by wall screens and a studio with a very special diffused natural light coming in through 38 hexagonal windows.

Being of a unique architectural form, it still looks modern while retaining authentic memorial atmosphere of the 20th century, reflecting the tragic life of this solo architect.

From 1929 to 2014 it was a home of the Melnikov family. Konstantin Melnikov lived here from 1929 till his death in 1974. His son, an artist Victor Melnikov lived here until his death in 2006. According to his last will the building became a part of the State Melnikovs Museum established in 2014 as a branch of the Schusev State Museum of Architecture. Since that moment on it is a non-residential building.

From 1929 to 2014, when the building was used as a dwelling house, the owners of the house themselves repeatedly carried out repairs and made minor changes to the structures. Restoration of the house began in 1982 with pre-restoration research, then it was repeatedly halted and continued until 1997.

View of the house from Krivoarbatsky Lane. 1930s

View of the southwest façade. 2016. Photo by D. Esakov

View of the northeast façade. 2016. Photo by D. Esakov

Since 1987 the house is listed as an architectural monument 'of regional significance'. In 2014 Russian Federal Government raised the monument's protection status to the level 'object of cultural heritage of federal significance'. Listed parts and features of the building are officially approved by the Moscow City Department of Cultural Heritage in December 2011.

The house was in the World Monuments Fund Watch list in 2006. The house is in DOCOMOMO list of outstanding monuments of the modern movement.

Since 2014 the Schusev State Museum of Architecture provides regular care and maintenance to the house. The Schusev State Museum of Architecture initiated the process to nominate the house for inscription in the World Heritage List in 2019.

Since December 2014 the building has been opened for public tours on a limited basis: one guided tour a day (up to five persons), taking into account the condition and constructive specificity of the House.

Since April 2015 the garden of the House is a public space, opened during daytime, with outdoor museum explications dedicated to the history of the House and Melnikov's biography, there is also a wooden model of the house.

The house was the first in Russia to join the international Iconic Houses Network in 2015. It is also a member of DEMHIST (International Committee on Historical Houses of ICOM). In May 2016 a twinning agreement between The Melnikov House and Villa Savoye (Poissy, France) by Le Corbusier was signed. The House has been visited by numerous guests since its opening for the public: architects, art historians, museum curators, artists and film directors etc.

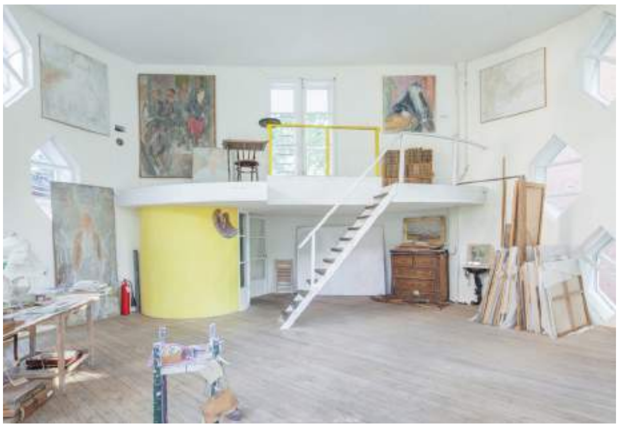
In the future, after completion of the conservation works, according to the last will of Victor Melnikov, the House will function as a museum object, opened for regular guided tours with a separate building nearby to exhibit works of father and son (more than 1200 architectural and art drawings by Konstantin and more than 1300 paintings and drawings by Victor).

Memorial content of the House will be preserved and presented to the public inside the House. According to preliminary registration, memorial and archival content of the House consists of more than 27 000 different objects: furniture, applied art, painting and drawings by Konstantin and Victor Melnikov, architectural drawings, sketches, notes, photos and negatives, official documents and many other invaluable archival materials about life of the architect, his family and the House, as well as objects of everyday life of the House. All this creates unique atmosphere of authenticity of the House that survived almost unchanged in the course of the 20th century. Memorial and architectural parts of the House are inseparable. Retaining some historic elements of the 20th century, the house also reflects the tragic life of the solo architect in a collectivist society.

Sky view of the Melnikov House from the northeast. 2018

After the completion of conservation works the House will be able to accept up to 10 – 12 000 visitors a year (comparing to approximately 2000 visitors a year nowadays) without risk to its condition in the long run. Recommendations about the maximum capacity and visitor management policy were elaborated in the course of the survey.

Living room. 1st floor. 2016. Photo by D. Esakov



Studio. 2nd floor. 2016. Photo by D. Esakov

Bedroom. 1st floor. 2016. Photo by D. Esakov

Dining room. View to the corridor and the main staircase. Ground floor

The Melnikov House in facts and figures

Location: the Melnikov House site is situated in the Arbat municipal district of Moscow city center at the address: 10 Krivoarbatsky Lane, 119019 Moscow, Russia (55°44′53″ N, 37°35′22″ E).

The plot of land is bounded by the apartment buildings #39 – 41 at Arbat Street and the apartment buildings #8 and #12 at Krivoarbatsky Lane. The plot of 836 m² is surrounded by a solid wood fence on east, west and north and by picket fence on south, facing Krivoarbatsky Lane with two solid main gates on both sides and a small single gate in the center, designed by K. Melnikov. There are crushed stone walkways and lawns around the House, there are fruit trees (apple, cherry and hazelnut) along south, west and north borders of the site. To the north of the house there is a big open space, which has existed throughout the history of the house, providing the necessary solar lighting and a view of the house. To the north of it there are beds of small vegetable garden which is reconstructed by the museum in 2018 – 2019. The land relief of the site is flat, characterized by a slight variation in altitude from 139.68 m to 139.19 m, and has a slope to the southeast toward Krivoarbatsky Lane.

Form of the building: two cylinders of different height, interlocking for a third of their 9.8 m diameter, with a straight-sided facet on the street façade, glazed from top to bottom. In a plan view from the south, the small cylinder is cut along a chord – the main façade with a large window and the entrance to the building.

Dimensions of the house: 9.8 x 15.8 m

Area of the house, including the basement and terrace: approx. 300 m³

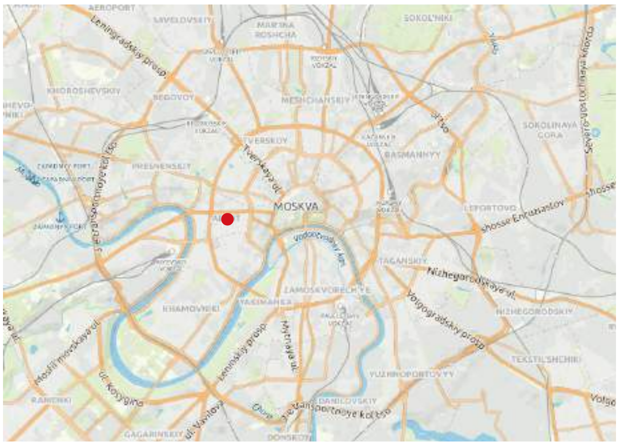
Volume of the house: approx. 1500 m³

Area of the plot: 836 m²

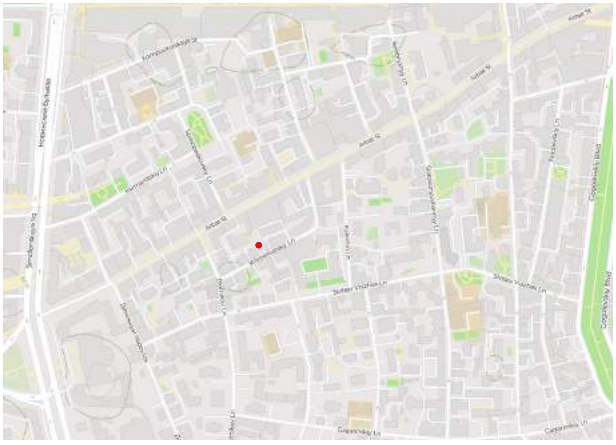
Ground area of the building: 136 m²

Interior area (inside walls): 101.1 m²

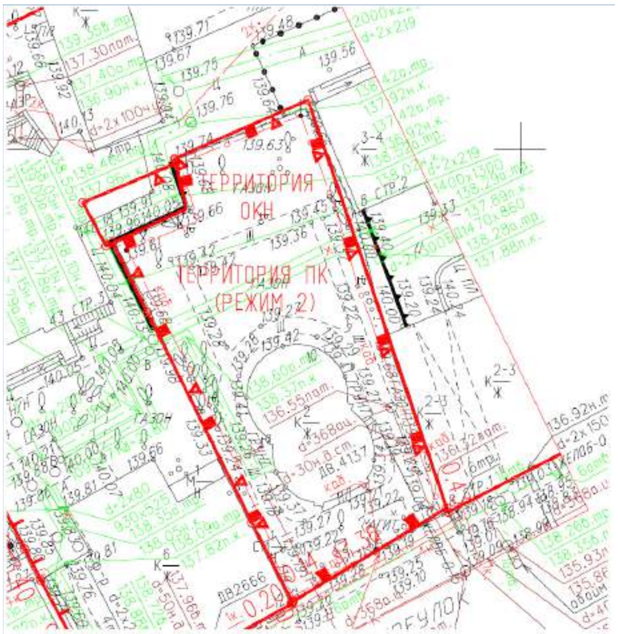
Small (south, front) cylinder has two floors and a



The Melnikov House on a map of Moscow



The Melnikov House on a plan of district of Arbat



General plan of the site. 2017

basement under a part of the building; on top of the small cylinder there is a terrace with enclosing walls and wooden deck. Height 8 – 8.65 m

Large (north, rear) cylinder has three floors and a single-slope roof with a small attic. No basement. Height 10.8 – 12.3 m

Ground floor space: height 2.7 m, area 96.5 m²

Living room: height 4.86 m, area 50 m²

Studio: height 4.79 m, area 53 m²

Bedroom: height 2.63 m, area 43 m²

Balcony-terrace: area 48 m²

Outer walls: plastered brickwork, thickness of the walls – 65–69 cm; a distinctive openwork design with a geometric grid of 119 hexagonal apertures arranged in chessboard order, except for the necessary supporting posts and crossbars

Windows: 62 – hexagonal ('honeycomb'); 1 – octagonal; 1 – gigantic glazed window (4.8 m × 3.9 m); 2 – rectangular windows right and left of the entrance.

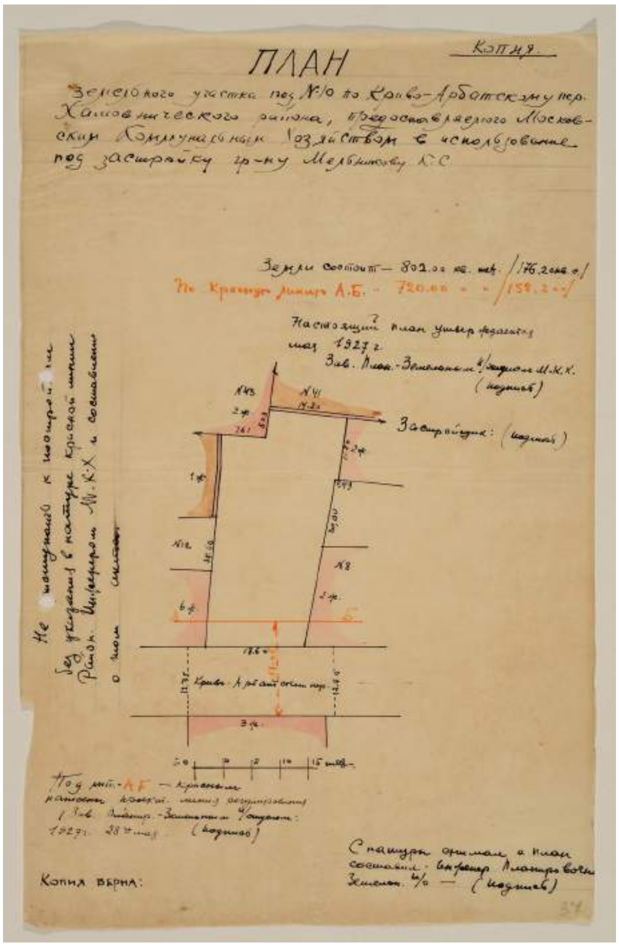
Intermediate floors: the wooden inter-floor membranes formed by a rectangular grid of flat boards placed edgewise, intersecting every 50 cm (except for reinforced concrete monolithic ceilings in the basement)

Attic: above the large cylinder – height to 88 cm with wooden girders, above the small cylinder – none, the ceilings above both cylinders are analogous to the inter-floor ceilings

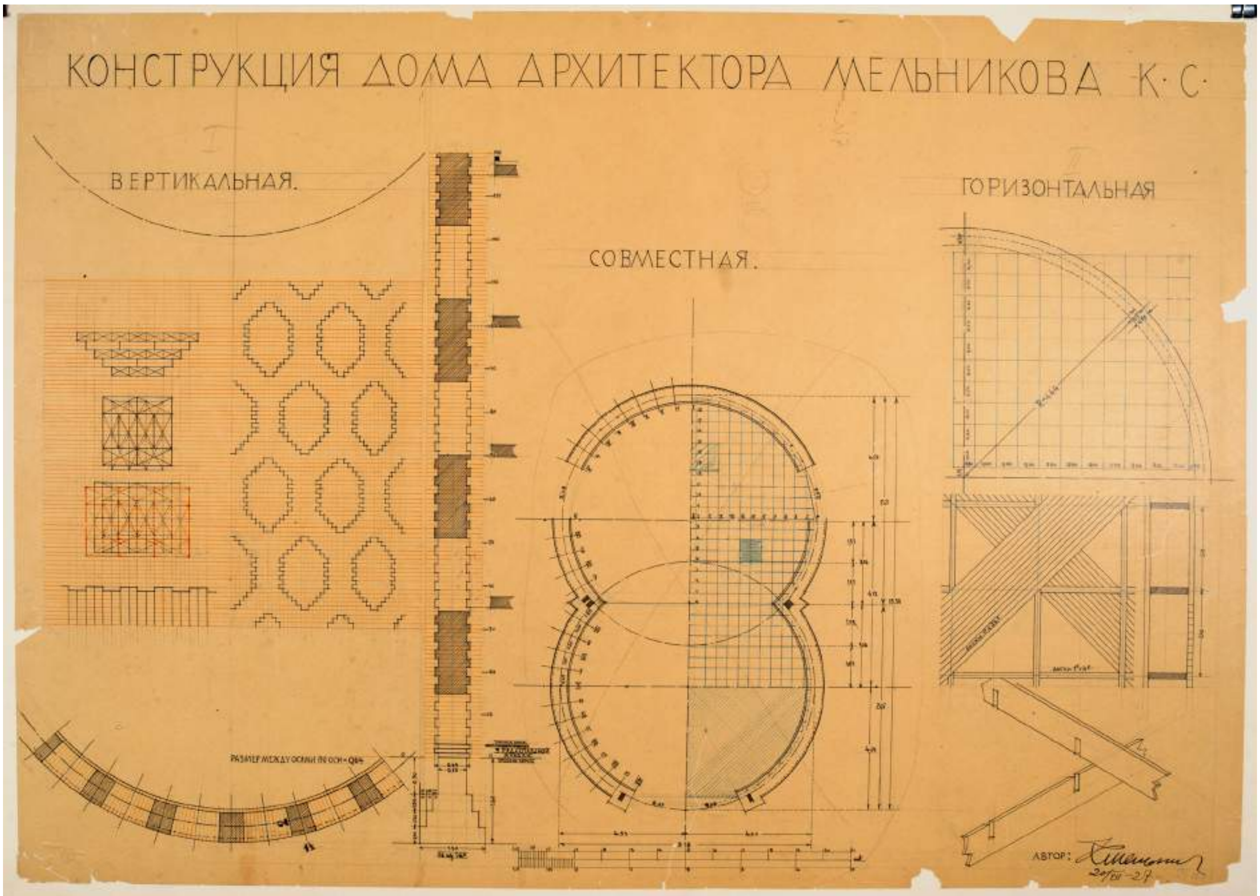
Roof: galvanised iron roofing, above the large cylinder – single-slope at an angle of 13°, above the small cylinder – corrugated with water drainage on two sides at an angle of 13°, wooden floor on the terrace

Basement: beneath part of the small cylinder, height 2.05–2.5 m, area 28 m², including the heating room 14 m²

Foundations: strip foundations of quarry stone to a depth of 2.95–3.15 m, partial use of pre-existing brick foundations



General plan of the site. 1927



K. Melnikov. Structural principles of the house. 1927

Load distribution: structurally, exterior brick walls transfer the load from the wooden (in the basement – reinforced concrete) joists and roof coverings to the rubble strips of the foundations. Inside the building there are two brick pillars at the ground floor level, based on old brick walls, and load-bearing (that used to be unloading) wooden partitions that transfer loads to their reinforced concrete strip foundations, arranged during the restoration of the 1990s, and floor joists of the basement.

Heating: initially – stove, from 1958 – central hot-water heating with warm air entering the rooms through a system of heat ducts running from the heating room in the basement of the house

Ventilation: inflow through two ventilation columns on the street façade and five small inflow vents along the perimeter of the ground floor, outflow through two former chimneys, placed symmetrically at the outer junctions of the cylinders

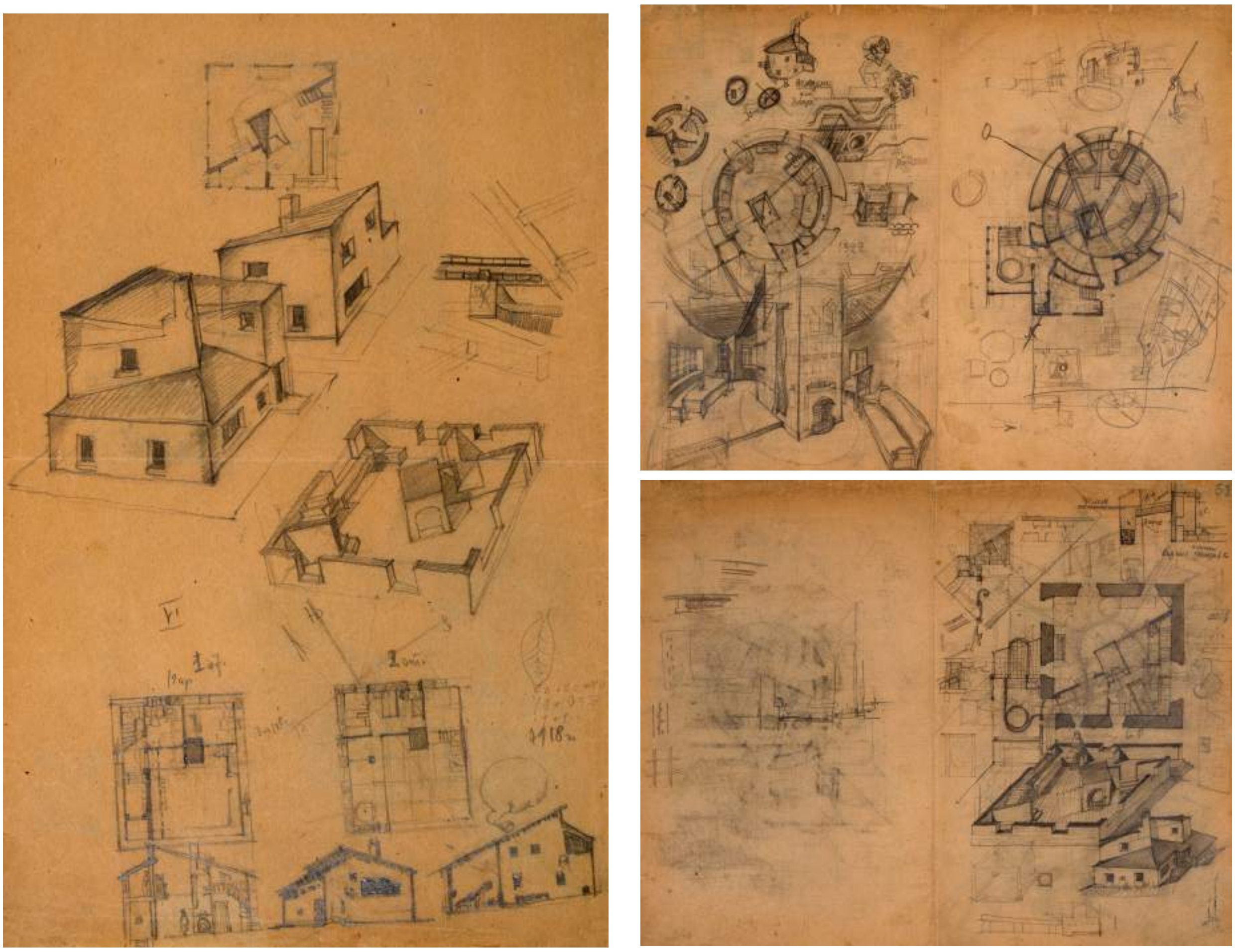
Documentary and archival research

Design, construction and life of the Melnikov House

Although the history of the Melnikov House is well known, this research has uncovered new previously unpublished materials (letters, daily records, construction budgets, etc.). Their analysis allows us to closely follow the process of design and construction of the building in 1927-1929 and significantly supplement the in-formation about the life of the house and its creator.

From the early 1920s, Melnikov had been dreaming of building his own house, partly to restore the living conditions that he was able to create for his family by designing the Moscow Automotive Society plant (*'MAO'* in Russian) before the Revolution, and the administration of the society provided him with a separate one-storey six-room mansion. The economic freedom that existed in Russia in the early 1920s made it possible to really hope for such an opportunity. The popularity of garden towns was in full bloom, and arrays of individual houses were built and designed on a cooperative basis in Moscow. Melnikov's financial and professional status, which had changed dramatically by the mid-1920s after he had designed a sarcophagus for Lenin's body and the USSR pavilion for the Paris World Fair in 1925, gave him a reason to dream of his own house-workshop in the center of Moscow.

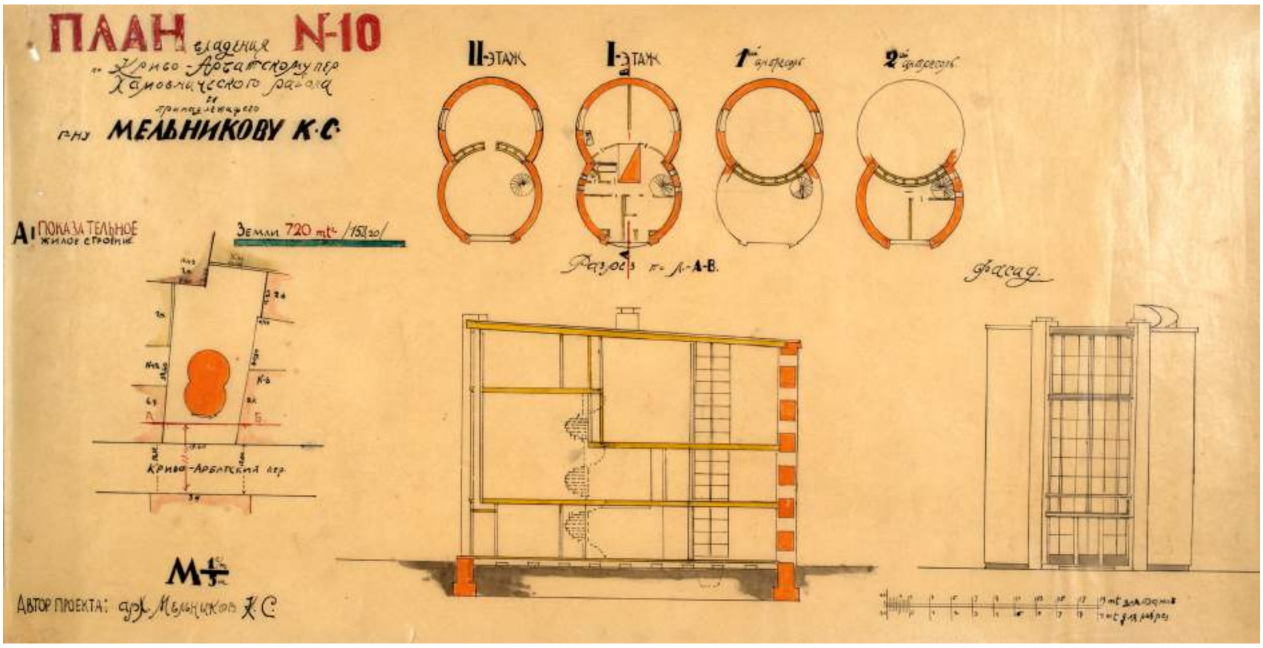
The existing sketches and designs from the early 1920s provide an insight into the nature of the



K. Melnikov. Sketches of the house-studio, 1918-1922 spatial composition, functions, and even the intended setting of the architect's future house. In one of the sketches there is an inscription at the top of the page 'a 10 × 10 ar [shin] square', that is, approximately 7 × 7 meters – the size of a very compact house with a stove set in the middle as the central element, from which partition walls extend. This early sketch already bears some similarities to the existing house, primarily in emphasizing the compositional role of the stove, which also remains in the original house plans, as well as in the composition of interconnected volumes unequal in height, which would later be reflected in the proportions of the 'large' and 'small' cylinders. The same principle can be found in other, more elaborated drawings.

The second variant, dated 1922, also has a working title: 'cotyledons or an egg'. Accordingly, the house plan in this version had an oval configuration, which is closer to the one that would later form the basis of the real future project. As in the first version, the central element of the composition is a stove, from which the 'rays' of ceiling beams and partition walls extend. The space of the building itself is only partially raised to the first floor, which makes it possible to assume that the workshop was always planned on the top floor with the possibility of roof access. Of particular note is the furniture depicted in the designs: an icon case, an Empire-style sofa, a table covered with a tablecloth, curtains – all these are real things that belonged to the family and were initially included in the house plan as elements of the furnishing complex.

This is how Melnikov described the beginning of the *'house history': 'In the spring, in February I filed an application for a plot in the 7th Rostov lane and they turned me down – the site is undersized and unfavourable. The whole family engaged in searching but found nothing. Then Buslayev introduced me to Gan – Gan immediately offered me № 10 at Krivoarbatsky lane – immediately filed an application and the next day a Committee meeting under the chairmanship of A. Domarev took place. I was so excited that I came to the meeting with a finished concept of the house and they gave me the plot.'* Judging by this record, the concept of the house was invented in one day – April 19, however, well-planned in advance. The direct prototype of the house was developed in March-April 1927 as a competition project of Zuev Club in Lesnaya street, which was a *'pipe organ with five cylinders'*. The competition resulted in the approval of Ilya Golosov's project, as Melnikov learned on April 9. Melnikov was

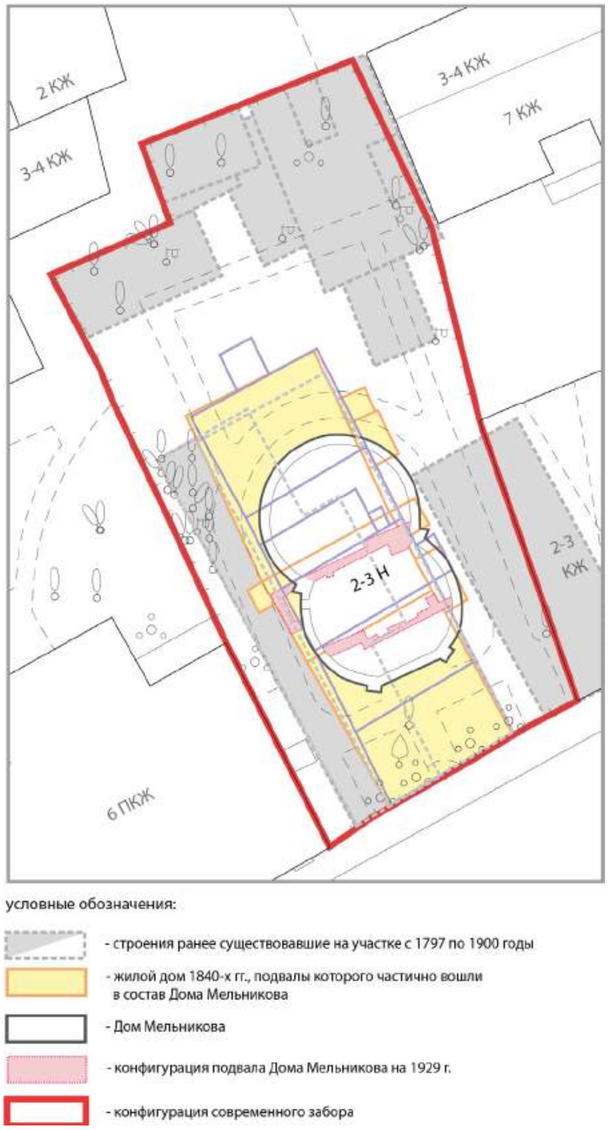


K. Melnikov. Original version of the House. 1927 very upset by the failure, but just ten days later the cylinders found their true place.

Inspired by the successful outcome of the search for a construction site, Melnikov wasted no time in developing the project of his dreams. In the surviving sketches in the architect's notebook we can see him trying to test the construction capacity of the site: three and even four cylinders line up one after another on the site, with pairs of cylinders crossing each other, to form a quarter-foil. In the end the architect decided on two cylindrical shapes, the same as in the project of the club in Lesnaya street, cut at a slight angle by the plane of a single-slope roof. A month later there was an area plot plan, design drawings, and a section model of *'Architect Melnikov's demonstrational house'*, which was presented by its author as a prototype of housing for workers.

Melnikov's records provide an opportunity to follow the construction process day by day. In order to execute a land lease agreement during the construction period the community services measured the plot at the end of May. On June 10, the contract for the house construction was signed. On June 29, the site was de facto handed over and on July 20 the initial design project of the house was approved, which was considerably different from the one subsequently implemented: without a basement, with a stove in the middle of the ground floor, with a mezzanine floor for children's rooms above the living room, with three-floor stained glass windows in both cylinders. On August 16, the water supply and sewerage project was complete. On August 17, Melnikov's statement on the construction of the house was approved. On August 22, the final draft of the house was drawn up, the next day the first cash deposit was made – 8900 roubles. On August 25, a work order was issued. Judging by how fast the progress was, one can get the idea of the immense organizational talent and experience Melnikov had and how much he wanted to start the actual construction of the house as fast as possible.

The construction of the building began on September 1, 1927, at which point Melnikov wrote



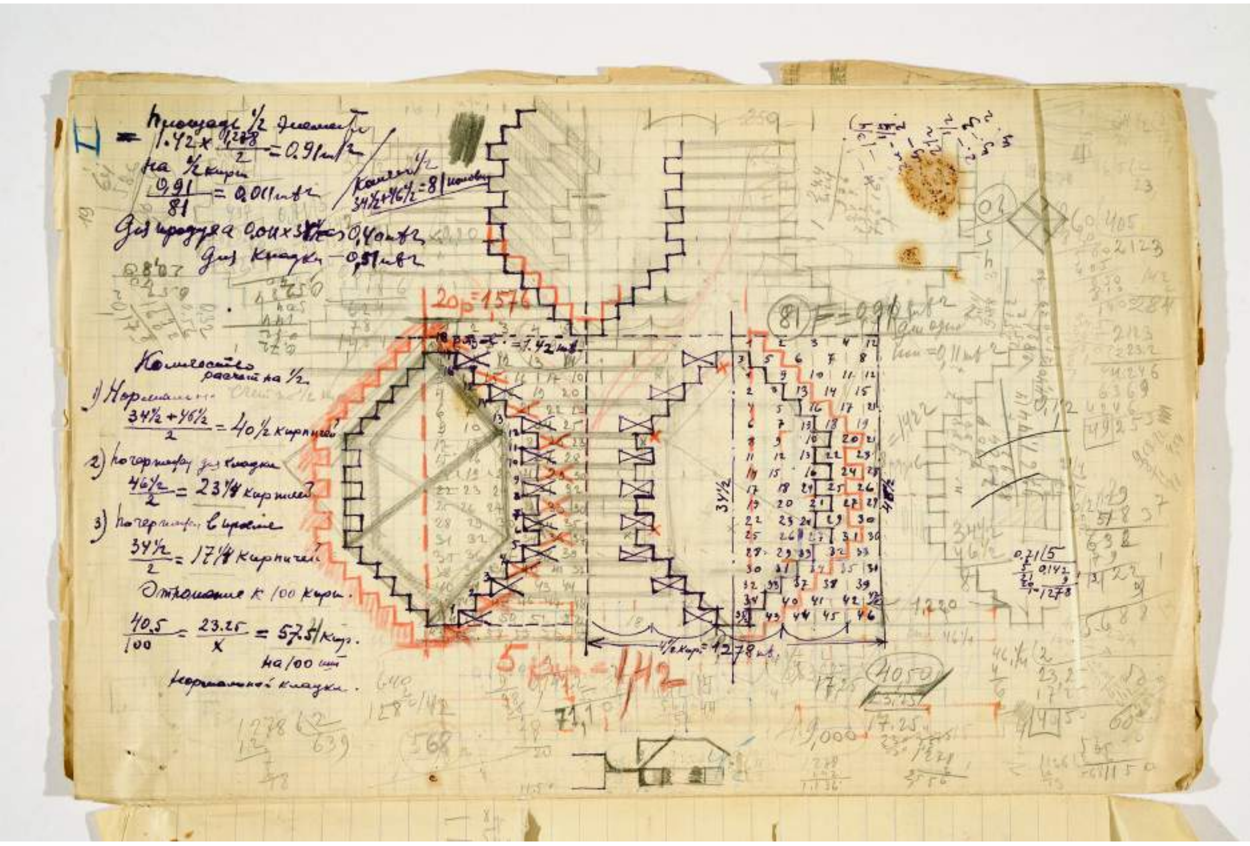
Matching of plans of the house and previous buildings of 19th-20th c.

Konstantin Melnikov and his son during construction of the house. 30 Sept 1927 on a sheet of a tear-off calendar, detailing the construction process: *'Started work on site (logs and barrows arrived).'* The architect himself enthusiastically engaged in the working process: he laid out the building on site, accepted construction materials.

In two weeks a construction pit was dug, and the workers found the remains of the basement walls of a house that had stood there before, which received a positive response, and, with a small adjustment of the depth of the newly erected rubble stone footing, the basement was included in the structure of the building under construction. There were several collapses of the construction pit during excavation, the old basement wall gave way and was 'propped up' by masons. On September 20, Melnikov wrote *'Big day. The house is under construction – I threw the first stone into the pit'*, and 10 days later the foundation was already finished.

On September 30, the workers started the brickwork and Melnikov wrote in the calendar: *'I arrived with Vitya at 7 o'clock in the morning for layout and laid the first brick (in the center of the back cylinder). Eight rows were laid today. There was a photographer. One photograph was taken.'* Looking at this famous and valuable photograph, which can now be dated accurately thanks to the calendar entries, we see the author-owner with his son, standing in the center of the newly completed foundation of the future house, construction workers, mountains of old bricks later used to close structural apertures *('produkhy')* in the walls, as well as barrels of Portland cement, barrows, pallets, shovels, wooden levers – the modest arsenal of building materials and equipment used to carry out one of the most avant-garde architectural projects of the day.

Then the progress slowed down: laying the lintels on the ground floor was rather difficult, as the bricklaying method was completely new and none of

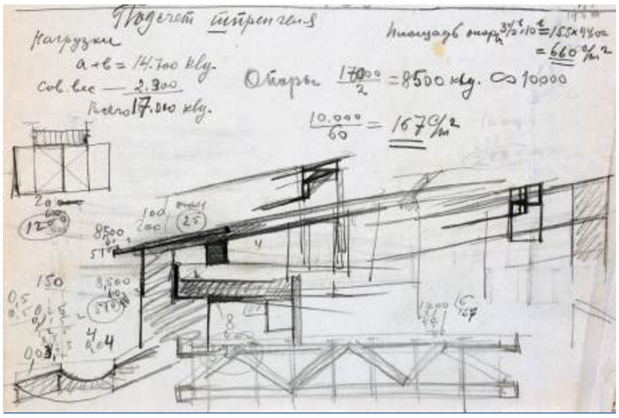


K. Melnikov. Sketch of hexagonal aperture with estimate of the number of bricks required. 1927 the builders had such experience, even though Melnikov had drafted all elevation views of the brick rows. Several collapses happened, there was an incident at the construction site when a worker was hit on the head with a brick. It was only on October 4 that the workers managed to bring together the lintels on the ground floor, construction works on higher floors were performed on scaffolding. In order to master the new bricklaying method special triangular frames called *'sreeder boards'* were used. By October 20, the exterior walls were mainly erected, and the builders began to make frames and plaster the ground floor.

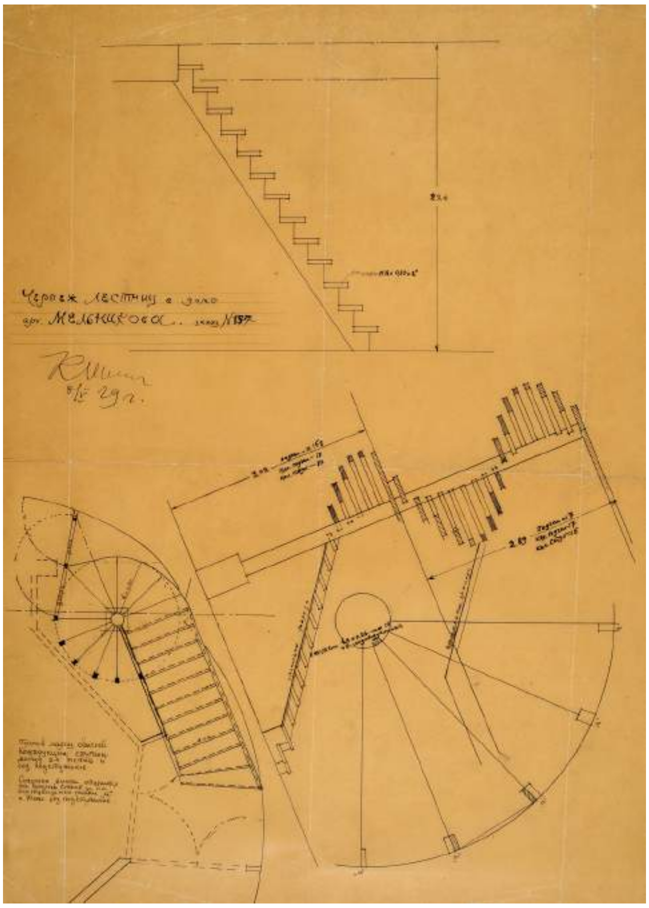
On November 2, masons completely finished all exterior walls. On November 12, the installation of the floors began, window frames were primed, a rail was laid above the entrance, which subsequently bore the load of the stained glass window. By mid-November, the ceiling joists had been mainly installed. It was an original formation of boards placed on the edge, cut into each other at right angles at 50×50 cm intervals, lagged on with spruce planks on top and bottom.

Understanding the experimental nature of the building, Melnikov recorded all the important stages of work. The construction of the ceiling joists was carried out with great care. On November 22, Melnikov writes: *'Finally! Installation of the ceiling joists is over; settlement is 14 mm (from wedges).'* However, two days later a note appeared: *'Still afraid to remove the scaffolding from the side of the first cylinder.'* On November 26, he decided to reinforce the ceiling: *'Installing a roof truss and covering the grid of the large cylinder with wood planks at the bottom.'*

The advance payment ran out, construction began to lose momentum due to the lack of loans, the Moscow Communal Service (MCS) issued an order to stop all work, but in spite of everything, work on the installation of ceiling joists did not stop, and on December 1, Melnikov wrote: *'all scaffolding removed, the ceiling joists are in place. The house is amazing.'* Thus, a tremendous job was done in three months: all in all, the house was built.



K. Melnikov Sketch of attic structures. North cylinder. 1927



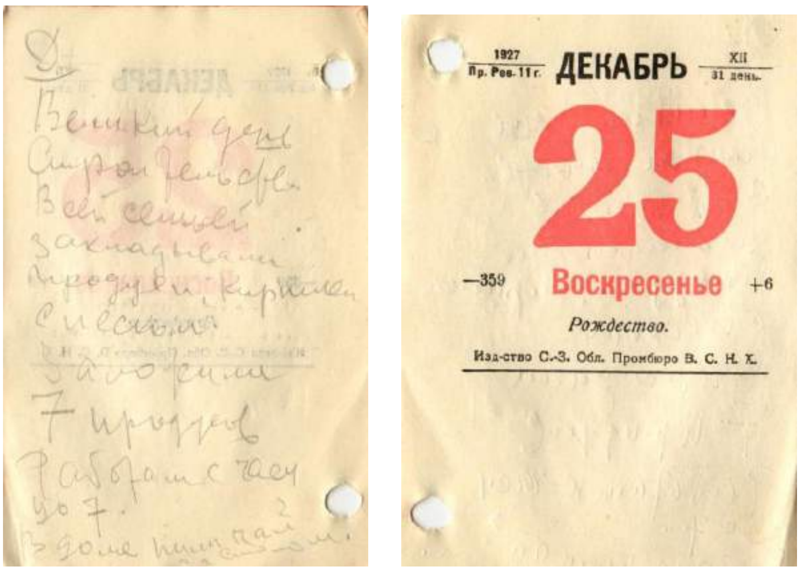
K. Melnikov. Drawing of the staircase. 1929

Photos were still taken during construction (noted December 4 and 7); perhaps they were necessary to keep track of the experimental methods of construction. The money invested in the construction ran out and on December 9, Melnikov was handed an official letter on the termination of work due to cost overrun of 5 000 roubles. Despite this, Melnikov made efforts to continue the construction work. The whole family took part in building conservation for the winter.

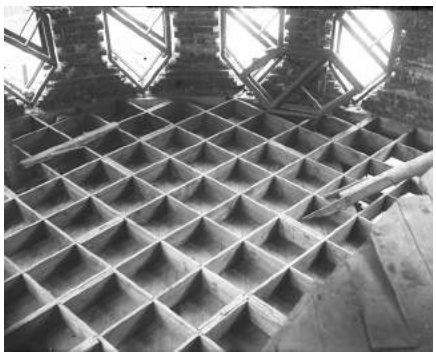
Every day new information about the house is added to calendar entries: December 20: *'the house is 'glazed', 10 degrees inside.'* December 25 (Sunday), *'A great construction day. The whole family filled the apertures with bricks and sand; 7 apertures filled. Worked from one to seven. Drank tea at the table in the house.*

Regarding the pace of construction, 1928 was not as successful a year as the previous one. Melnikov tried to hire a brigade on his own, but the construction department was uncompromising and forbade even the architect himself to appear at the construction site. Construction was resumed only on January 17: winter frames were installed, and the installation of heating system pipes began. Observing the construction work, Melnikov writes in his diary with great concern *'the plafond sagged greatly.'* In mid-February, the carpentry on window frames was finished and the installation of internal partitions began. By the end of February, the floors in the rear cylinder had been finished, the house was dried with the stove. On February 28, *'everything was suspended and closed down'*, but thanks to the perseverance of the architect the work was intensively resumed.

Melnikov's financial troubles, the involvement of various committees and the search for protection of important people to settle with the Construction Committee took place against the backdrop of the persistent continuation of work on the house: Now counting only on himself and his loved ones, Melnikov worked on all the window jambs and isolated the front frames, built a staircase to the basement. On April 29, he wrote: *'I worked sick today. So did Nyusha. I laid tar paper under the window, Nyusha painted (primed) the doors. Both of us were really tired. Tired body and soul!...'*; April 30: *'I arrived in the morning again (got up at 6 am, the same as yesterday) and worked sick. So did Nyusha. Both were terribly tired (body and soul). I painted window frames, Nyusha primed doors again'*; May 2: *'Worked sick alone again from morning till night, extremely tired. Covered the inside of the windows with plywood and primed it. Haven't eaten anything all day.'*



Tear-off callendar page with records by K. Melnikov. 25 Dec 1927



Membrane structure between the 1st floor bedroom and 2nd floor studio during construction. 1928

Melnikov's psychological condition caused by the wave of troubles haunting him during this period was critical. Strongly depressed by adverse circumstances, he writes on May 9: *'I want to have a house so much – and yet – I don't want anything!?'*. Despair and uncertainty make him continue to fight for the house. May 13: *'Repaired the roof, smeared all over with tar'*; May 15: *'Worked all day long. Dug ground at the gate. Very tired'*; May 20: *'Still working. Taking the sawdust to the shed. Very tired'*; May 21: *'There was a downpour, the roof looks like a sieve'*; May 22: *'repaired the roof and relaid spruce planks'*; May 24: *'Worked sick the whole day from morning till late evening - sealed the subfloor of the front cylinder.'*

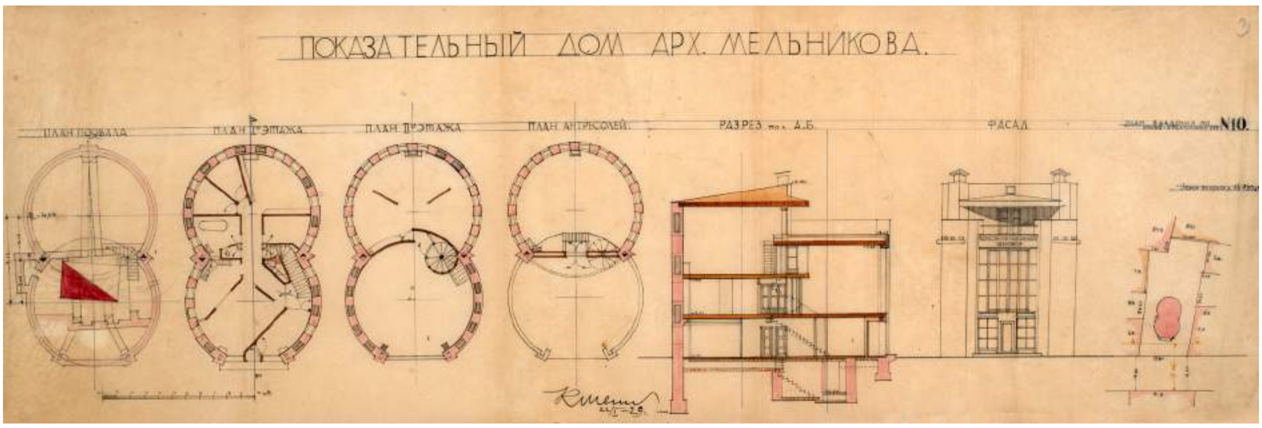
Of particular concern were leaks in the flat roof of the small cylinder. Melnikov eliminated this problem by designing original seam metal roofing covered with a wooden plank floor of the outdoor terrace.

Melnikov spent the whole summer of 1928 severely stressed over the uncertainty of the future of the house. If we consider that all these events took place against the background of the architect's full involvement in the implementation of his best projects, we can imagine how difficult for Melnikov his so-called 'golden' period was.

Melnikov originally wanted to acquire ownership of the house, hoping to pay for it with the fees for 'mass orders', which rained down on the famous architect in 1927. However, the construction turned out much more expensive, and at some point there was a threat that the house would be repossessed. The struggle for the house was of a debilitating bureaucratic nature, which, perhaps, was really connected, as Melnikov thought, with the desire of some specific people to *'take over the house'*. MCS leaders who sympathized with Melnikov offered to include the house in the city asset list and lend it to Melnikov. Melnikov agreed on condition that personal funds which had already been spent would be offset against future rent payments.

On October 4, after a long break, workers finally got the job order for further construction of the house; on October 10, Melnikov wrote with satisfaction: 'work is in full swing'. Everything came to life again: On October 19, the gas plant provided gas supply; at the end of October, the house was equipped with electricity and stoves; on November 14, the air-heater construction began, which was completed on December 15; on December 31, wall partition between the children rooms was plastered.

The whole year of 1929 was spent on finishing works in the house to prepare it for commissioning. Construction and finishing work were carried out virtually without a break, despite the constant administrative inconsistencies with MCS and work suspension. The whole façade was plastered, painting works inside and outside were finished. The



K. Melnikov. Final version of the House. 1929 house was connected to sewage, running water, and gas. The ventilation and heating system started working.

Despite the fact that the Construction Committee officially proposed to sign a lease agreement for the house on October 20, 1928, Melnikov was in no hurry to sign it, continuing to come up with various schemes of house completion. The architect tries to prove the public importance of his building, and within three days, on January 6-8, 1929, he designs three projects based on his construction principle: 'House of the Commune', 'Architect Melnikov's house project', 'Application of Architect Melnikov's House construction principle in the block system'. At the same time, an article about the house is published in a professional magazine 'Moscow Construction', discussions are organized, study tours are conducted in order to promote the new system. However, Melnikov manages to get a loan for the completion of the house from the Bank of Moscow and finally pay the debts only after June 30, 1929 after he has already signed the lease agreement.

Finally, on August 18, 1929, the family solemnly moved into the house, with all traditional rites: *'Brought an icon, bread, salt, a cat...'*

The Melnikovs continue with the decoration of the house, the fence and yard improvement with their own money. Only on November 29 the certificate of occupancy of a *'newly rebuilt two-storey stone house with attic'* was issued. Despite some *'design deviations'*, including the construction of a basement, it is stated in the certificate that *'there are no obstacles to occupation of the building'*.

After the commissioning of the house it was still being retouched and redone during the first half of the 1930s. Almost all construction work falls on the family members. The utility networks and systems of the new house are being improved and adjusted. Due to several carbon monoxide poisonings of the family members, Melnikov adjusts the ventilation system of the house and designs additional holes in the lower part of the pilasters to increase air draught. The house is equipped with a private telephone line, which was still rare at that which was still rare at that time.

V. Melnikov. Study of the 'golden' bedroom. Early 1930s

K. Melnikov. Living room. 1940s

K. Melnikov. Anna Melnikova in the living room. 1940s

1930-1941 can be described as a short period of existence of the house in its original concept devised by the architect. The diary entries of 1930 record the work carried out by the family on the site improvement, planting a fruit and vegetable garden, building a sports ground and laying out flower beds. The site gets a well-maintained look. After a long vacation in the Crimea and the Caucasus Melnikov writes on August 11: *'We were away for more than a month. The house struck us: none of us expected it to look so good, high, harmonious and majestic. Its inside is higher than the outside. Everyone was amazed by nothing else, but the house. The garden grew bigger and prettier. It is cozy on the playground. The vegetable garden is blooming, which gives a sense of richness and contentment. It is literally a mansion.'*

The most difficult period for the building was from 1941 to 1952, associated with significant losses and alterations of the author's original concepts. During the bombing of Moscow on July 23, 1941, the blast from a bomb that hit the Vakhtangov Theatre (200 m from the house) knocked out most of the window panes in the area of the explosion, including the Melnikov house. The building remained in this condition for several years. 1941-1944 the architect's family had to spend the winter in the basement, where two beds and a stove for cooking were installed. The windows of the house were covered with makeshift materials: plywood, boards, pallets, and the remains of glass held together with bandages soaked in oil paint. To keep the house warm, Melnikov builds temporary furnaces. Later, a new stove (preserved to date) was built in the living room replacing the collapsed one. Temporary furnaces worked on the other floors as well, but this was not enough: due to abundant moisture, floors and partitions under the central stained glass window in the living room rotted. The bedroom ceiling collapsed, which partially affected the unique architectural design made of Italian alabaster, decorated with natural stone imitation.

After the war, the Melnikovs begin to put the house in order together with reconditioning it for the young family started in 1940. 1949-1951 K. Melnikov and his wife live in Saratov, where he teaches at Saratov Road Institute, coming to Moscow from time to time. The house is being renovated and partially replanned: two internal partitions on the ground floor are taken down (one divided two children's working rooms, another separated the toilet room and the housekeeper's working room), an additional entrance to the house from the yard is arranged (it was sealed during restoration in 1992-1993). The air-heater starts working again, at first on wood, then coal. Temporary furnaces on the ground and second floors are dismantled. The whitewashing and painting is almost completely washed off the walls and ceilings, the surfaces are treated with a solution of copper sulfate and rewhitewashed. Ceilings and one wall (yellow) in children's rooms and the toilet room are repainted, the dining room is freshly wallpapered. In the bedroom, lodge beds and floor plaster covering are removed. The plastering of walls and ceiling is repaired. The walls are covered with wallpaper, and the ceiling with white paper.

Until the end of 1950s the young family lives in two rooms on the ground floor of the large cylinder. After the return of the older generation in 1952, K. Melnikov negotiates with the local authorities the approval of a project of ground floor replanning, according to which the refrigerator is replaced with an additional door, two partitions are dismantled and a new one is built, which separates the room for a young family. This project served for the legalization of works already carried out in 1949-1952.

In 1958, the building was connected to the city heating systems, the collector went through the yard, and the stove heating was replaced by water heating; the chamber of the air-heater located in the basement was equipped with central water heating radiators, and the unnecessary coal hatch was bricked up. The bedrooms were wallpapered again.

In the early 1960s, when the new paradigm gained a foothold in architecture, the professional community shows interest in the avant-garde of the 1920s, including the works of K. Melnikov, who was rehabilitated. The house of the architect had strongly fallen into disrepair by then. On January 14, 1964, Melnikov writes a personal letter to the Chairman of the Moscow Soviet with a request for assistance in house renovation. As a result, the active interaction of the architect with the Repair and Construction Department of the Frunzensky district begins. It is already noted in the documents of this time that the house belongs to Melnikov *'as private property'*, and renovation has to be paid for by the owner. The repair budget included a large scope of work, but Melnikov found the renovation cost quite high. At his request, the Moscow branch of the Union of Architects has repeatedly appealed to various authorities to recalculate the budget at a more sparing rate *'for the pensioner of national importance'*.

1927

масштаб 1:500

условные обозначения:

каменные строения
- сохранившиеся
- утраченные

деревянные строения
- утраченные

2Ж - двухэтажное жилое
Н - нежилое
М - с мезонином
П - с подвалом
п/п - с полуподвалом

границы домовладений
- сохранившиеся
- утраченные

- утраченные каменные ограды, брандмауэры

432 - номера исторических владений

1990

условные обозначения:

каменные строения
- сохранившиеся
- утраченные

деревянные строения
- утраченные

2Ж - двухэтажное жилое
Н - нежилое
М - с мезонином
П - с подвалом
п/п - с полуподвалом

озеленение
- сохранившееся
- утраченное

границы домовладений
- сохранившиеся
- утраченные

- утраченные каменные ограды, брандмауэры

14 - номера владений

Melnikov House quarter, 1927 and 1990

As a result, the scope of work was reduced and only the roofs of both cylinders underwent repair: the original coating was dismantled and replaced with 2 layers of roofing felt, placed on tar oil with the construction of new rainwater system. The quality of the work was very low and in May 1965 K. Melnikov wrote a complaint to the organization that performed the ill-fated roof repair: *'The repaired roof of the experimental demonstrational house № 10 in Krivoarbatsky lane did not hold even a year of testing; the roof of the small cylinder leaked on the right in several places, ruining the whitewashed ceiling'.*

After the death of K. Melnikov (1974), in 1976, the house underwent major renovation: the façades were rubbed with cement mortar and painted with glossy white paint, which gave the building a shine not corresponding to the original plan; the window sashes were painted dark brown, drip strips under the windows were painted silver grey. It is interesting how the color of the house was perceived by the English writer Bruce Chatwin in 1973: *'...the stucco there was a dull and flaking ochre...'*

In the early 1980s the house becomes widely known. By the order of the Russian National Society for the Protection of Cultural Monuments ('VOOPIK'), *'Spetsproektrestavratsiya'* Institute performed complex measurements of the building and developed a project for the restoration of the house (supervised by Vladimir Rezvin). In 1989 the restoration of the house began with the proceeds from the sale of catalogs at the exhibition of the artist Günter Jücker (Germany) in Moscow. For the careful execution of works scaffolding was constructed that did not come into direct contact with the house, but after dismantling of the roof and ceiling of the large cylinder, all work was suspended for lack of funds. In 1990, the front door of the kitchen was dismantled, the wall refrigerator was restored in its place in accordance with the original project.

In 1992-1993 the architectural studio of Alexander Popov carried out works on the replacement of the roof structures on the large cylinder and the restoration of the roof on the small cylinder, which were not completed either due to lack of sufficient funding.

In 1996-1998 Restoration experimental engineering workshop № 5 (directed by Marina Kapustina) carried out works on the restoration of the house. During this restoration the most significant amount of work since the construction of the building was performed: roof repairs on both cylinders were finished; ground floor ceiling of the small cylinder was reinforced, the flooring of the first floor was replaced; the ceiling of the large cylinder was levelled and flooring was renovated; the flooring on the ground floor was completely replaced; foundation was placed under the ground floor wall partitions; two partitions on the ground floor were restored; plaster layers were renovated, the interiors were repainted; the façade of the building was completely renovated. The restoration works were accepted in 1997, but the correction of deficiencies (mostly related to site improvement) proceeded till 2000 when changes were made to site improvement and the blind area of the building was remade – the concrete screed was removed and replaced by a clay screed.

In 2000-2010, when construction in the neighboring areas intensified, several surveys were carried out to monitor the condition of the monument and elaborate recommendations for its preservation.

In 2014 the Melnikov House becomes a listed building of federal importance and part of the State Konstantin and Victor Melnikov Museum, a branch of the Schusev Museum of Architecture. In December 2014, it opens for visitors. In the spring of 2015, the courtyard underwent landscaping and was opened to the public, along the perimeter of the site and from Krivoarbatsky lane the fence is made according to a restoration project reconstructing the original gates and design of fence sections. Currently, the courtyard, which has gained great popularity as a cultural public space, is part of the museum's exposition: flower beds and vegetable garden are restored on their original places, old garden trees bear fruit and are maintained in good condition. The wooden shed originally located on site has been restored and adapted for museum services (selling tickets, books, souvenirs).

The conservation status of the Melnikov House

Due to its uniqueness and experimental nature, the Melnikov House has always been perceived as an outstanding work of architecture. However, it received the status of *'architectural and urban monument of local importance'* along with other buildings of the Soviet period only in 1987.

In 1992 the Presidium of the Moscow City Council gives it the status of a *'historical monument'* with the title *'House of the architect K. S. Melnikov, in which he lived and worked in 1920-1974'*. In the same document, the building was recommended for state protection as a monument of republican significance with the name *'House in which the outstanding Soviet architect K. S. Melnikov lived in 1920-1974'*.

After the law *'On objects of cultural heritage (historical and cultural monuments) of the peoples of the Russian Federation'* came into effect in 2002, the house was attributed to the objects of cultural heritage of regional importance.

By order of the Government of the Russian Federation in 2014 the house became an object of cultural heritage of federal importance.

The monument is located within the boundaries of the unified security area, development regulation area, as well as the area of protected cultural layer, within the boundaries of the cultural heritage object (archeology monument) of federal importance *'The cultural layer of Zemlyanoy Gorod, XVI – XVII centuries'*.

In 2010 the Government of Moscow defined the boundaries of the monument and detailed land use regulations:

1) the prohibition of capital development, change of the subject of protection, the distortion of traditional characteristics of the current composition of the historical development of the building, changes in the characteristics of the natural landscape associated with the object of cultural heritage on a composition level;

2) the restoration of the objects of cultural heritage, conservation and restoration of historically valuable city-defining buildings, elimination of discordant objects, landscaping and improvement of the territory according to the project of restoration and adaptation agreed in accordance with the established procedure; ensuring availability of objects of cultural heritage for the purpose of their display; ensuring preservation of traditional visual perception of the object of cultural heritage from the main scenery spots and viewing points; ensuring measures of preservation of the object of cultural heritage, fire security, protection from dynamic impact; attention to fire security measures in the object of cultural heritage;

3) restoration of the lost structural elements of the historical building which had important compositional value; reconstruction of utility networks and roads without compromising the integrity of the objects of cultural heritage or threatening to damage, destruct or destroy them.

In 2014 the Ministry of Culture of Russia included the Melnikov House in the property of the Schusev State Museum of Architecture. Since then the house, a former residential building for 85 years, became a museum.

Currently, the Museum of architecture and the Ministry of Culture of Russia have started the preparatory work for the inscription of the Melnikov House into the UNESCO World Heritage list.

In 2011 the Moscow City Department of Cultural Heritage approved the listed features of the Melnikov House, which included the main valuable historical and architectural characteristics of the building. According to the results of the conducted research it is advised to make additions and clarifications to the existing listed features.

The proposition for the listed features of the Melnikov House

1) architectural characteristics of the building, its location and role in the composition and planning structure of the property, quarter and street frontage of Krivoarbatsky lane.

2) Three-dimensional composition of the building of 1927-1929, consisting of two cylinders of different heights (8.0–8.65 m and 11.0–12.3 m) interlocking for a third of their diameter of 9.8 m:

· the small cylinder (horizontally cut from the side of the main façade) is two-storey with a basement (dating back to the first half of the XIX century) and a roof used as an outdoor terrace,

· the large cylinder is three-storey with a single-slope roof inclining in the direction of the courtyard thus forming an attic;

· two brick towerlike pipes (chimneys) of diamond-shaped section fixing the line of intersection of cylindrical shapes on the outside.

3) Design, configuration, elevations, roof material of 1927-1929, the material and nature of the roofing, including ribbed seam roofing of the small cylinder and wooden flooring of the roof terrace.

4) the system and design of the drainage of the 1930s.

5) Composition and architectural and artistic design of the façades of 1927-1929, including the number, location, material, shape, size and design of window and door openings of flat and cylindrical surfaces of the façade, including:

· the door of the main (single) entrance to the house with a rectangular canopy, embedded in the inter-storey cornice, concrete entrance area framed by iron angles;

· rectangular six-glass double-sash windows flanking the main entrance on both sides;

· stained glass window of the first floor (30-glass window sash);

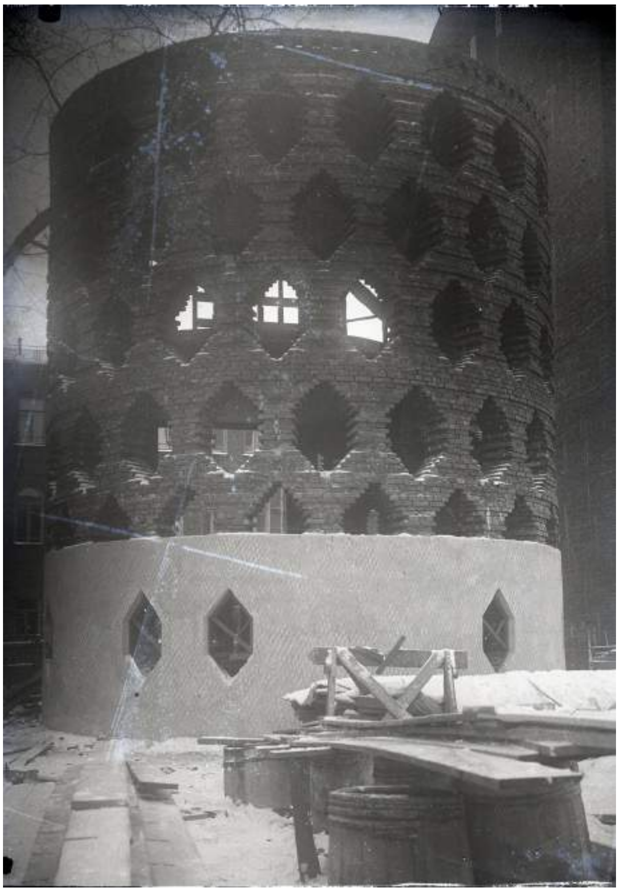
· font centric composition in two lines on a flat rectangle crowning the main façade:

KONSTANTIN MELNIKOV
ARCHITECT

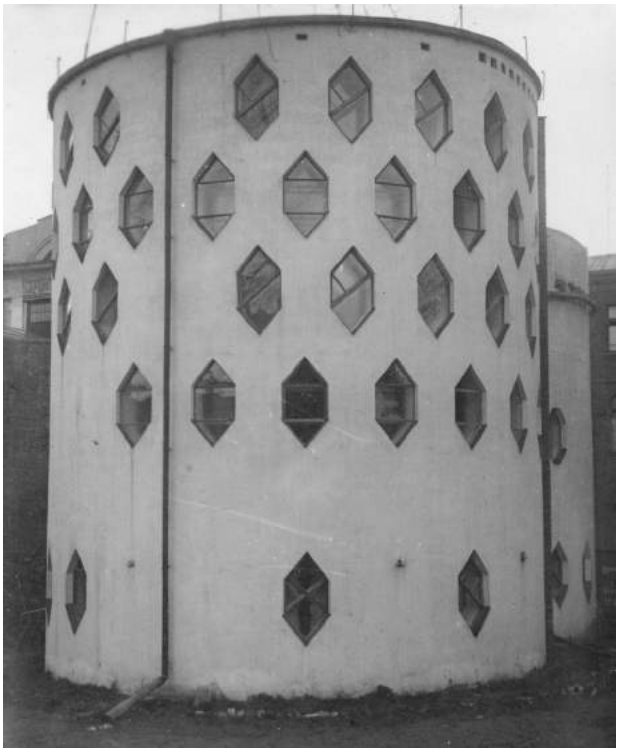
· blades (air duct) along the entire height of the small cylinder, including the terrace parapet, accentuating the main façade;

· an octagonal window on the west side of the small cylinder at the 1st floor level;

· 62 hexagonal vertical windows (12 on the ground



The house in process of construction. 1928



View to the house from the northwest. 1930s floor, 12 in the bedroom, 38 in the workshop) of three types of glazing (three-glass double wooden sashes), located on the cylindrical surface of the façade in five levels;

• double-leaf glass door to the terrace (double six-glass sash) with a canopy formed by the round ceiling part of the large cylinder;

• terrace fencing: solid brick plastered parapet with a central opening, decorated with ornamental metal fence;

• elements of the ventilation system – 'lines' of through rectangular holes on the lower level of the terrace parapet and in the area of attic ventilation of the large cylinder, two air intake grilles on the main façade; five mini-vents on the ground floor (dining room, two children's rooms, dressing room, housekeeper's room).

6) Unique structural design of the walls laid out on a strip rubble stone footing of two intersecting rings forming an openwork frame (patterned full brick masonry) of hexagonal apertures, some of which were used for window openings, others were sealed.

7) The design and material of the ceilings, including membrane structures made of boards placed on the edge and cut into each other at 50×50 cm intervals (K. Melnikov's structural invention), reinforced concrete monolithic ceiling over the basement.

8) Material and finishing of façades of 1927-1929 (plaster, painting), joinery filling of window and door openings.

9) Color scheme of the façades (to be specified in the restoration project).

10) Space-planning structure of the interiors of 1927–1929 within the load-bearing walls, pillars, ceilings, doorways, partitions, mezzanine balcony of the second floor with access to the terrace.

11) Location, design, material of interior partitions including two radial screen partitions in the bedroom.

12) Decorative design of the house interiors including: tongue-and-groove spruce board floors, plastered walls, plaster-moulded three step cornices in the rooms of the ground floor, the baseboard made of bent boards along the perimeter of the premises; wooden paneled sliding doors, including the unique design of a 'rotating' door of the ground floor;

13) Location, size, shape and decoration, color scheme of built-in furniture of 1929: toilet room cabinets, kitchen equipment, including a refrigerator.

14) 'Suprematist' stove in the living room of the 1940s: design, shape, material, surface treatment, color scheme.

15) Staircases of 1927-1929, their location, design, material and decoration, including the main wooden spiral staircase with center support bound with metal sheets and straight, winding stairs; a one-flight wooden staircase to the mezzanine balcony with access to the terrace, a brick staircase descending into the basement.

16) Color scheme of the interiors, including colored triangles on the ceilings in children's rooms and a color sector on the ceiling of the toilet room, the original color of the walls of the premises (to be specified in the restoration project).

17) Items of memorial value, including the original archives of the architect K. Melnikov and the artist V. Melnikov (the list to be approved by the Ministry of Culture of Russia).

18) Air-heater heating and ventilating system of 1929, including vent ducts and grilles, and the waste incineration channel.

19) The system of 'exposed' wiring on porcelain insulators, light fittings.

20) 'Acoustic' telephone system of 1929.

21) Location, construction, material, elevations of the fencing of the site of 1929 in regard to the changed configuration of intra-quarter fencing of the 2010s, including the gate of unique design (to be specified in the restoration project).

22) The location of the wooden household structures in the yard, which existed until 1974.

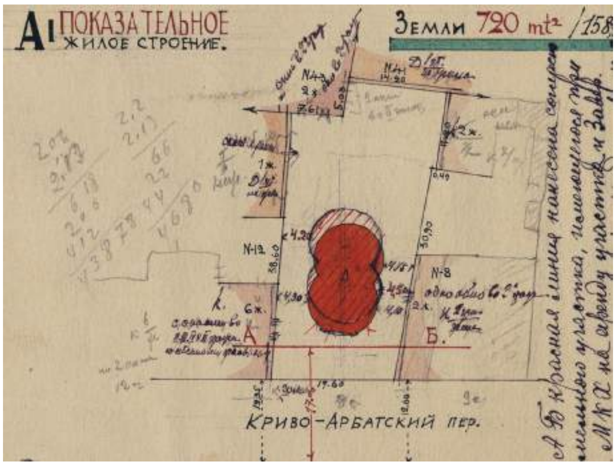
The evolution of the Melnikov House visual perception

The quality of urban environment played an important role in choosing the territory for the construction of this experimental residential building. For Konstantin Melnikov, who had a fine appreciation of the architectural fabric of the city, the area of the lively, densely built-up Arbat street adjacent to quiet alleys drowning in greenery, including Krivoarbatsky lane, one of the most intimate ones, was extremely attractive. As a result, the undeveloped plot № 10 was immediately approved by the architect-developer.

In 1927, when construction began, the buildings in the central part of the city, mainly mansions and occasional tenement buildings, were in good condition despite the severe consequences of the revolution and the civil war. The buildings of Krivoarbatsky lane, including the neighboring plot № 12 and most of the buildings on the odd side, were mainly built at the turn of the XIX–XX centuries.

From the far side of the plot there was a view over the Church of St. Nicholas in Plotniki built in the late XVII century at the corner of Arbat street and Plotnikov lane. It is interesting that the free placement of the house in the middle of the plot by Melnikov, with a margin from all boundaries, resembles the traditional placement of church buildings. However, it should be noted that such a significant setback of the building from the red line was dictated not so much by the desire to make the building look more monumental, as by the town-planning regulations of that time.

The measurement and design drawings of the site show the current line of urban planning regulation – the result of the project of redevelopment of the central part of the city in the early 1920s. The evolutionarily formed dimensions (width) of Krivoarbatsky lane equal to 12.35–12.60 m were to be broadened to 17.06 m, and the expansion was supposed to be towards the even side, reducing the width of the properties by almost 4.5 m. Currently, the house sets back from the red line by 6 m, from which we can conclude that K. Melnikov orig-inally intended to place the house much closer to the lane, which was prevented by the results of the short-term urban policy of 1920-1930s. For the same reason, the area of the plot on the measurement drawing of 1927 is stated as follows: 720 sq. m accounting for the red line, 802 sq. m disregarding the red line (current plot area is 836 sq. m).



Fragment of general plan. 1927

The space-planning composition of the properties in the quarter formed perimeterally: originally the courtyard of K. Melnikov's house was formed by the walls of neighboring household buildings, with the exception of two fragments, partitioned by boundary fences. The scale of the buildings was mainly small and medium (2-4 floors), with the exception of two six-storey tenement buildings, one of which (12 Krivoarbatsky lane) separated the south-western boundary of the front yard of K. Melnikov's house with its firewall,and the other was located on the opposite side, at the intersection of Krivoarbatsky and Plotnikov lanes. The intra-quarter spaces preserved fragments of manor gardens, hiding small household buildings in the foliage.

Melnikov, who was attentive to the panoramic views from the house windows, designed a special octagonal window on the west side, framing a magnificent view of the Church of St. Nicholas in

View from the living room to the Church of St. Nicholas in Plotnikov lane. Reconstruction, 2018

K.Melnikov. View to the Church of the Transfiguration in Peski. 1955

Plotnikov lane, through which rays of the evening sunlight fell into the living room. Unfortunately, by the end of house construction the church had been closed and completely demolished in 1932. The church was replaced by a six-storey residential building (45/24 Arbat St.) designed by architect Polyakov, which formed, with local setback from the historical red line of Plotnikov lane, the development front of the western end of the quarter. Thus, not only the view over the church from the house of K. Melnikov was lost, but also the visibility of the house itself from Plotnikov lane.

Thanks to the unusual construction and numerous windows, K. Melnikov's house was visually connected with other essential city landscapes. From the roof terrace of the small cylinder there was a view over the fragment of the Kremlin lost in the 1970s after the construction of the Central Clinical Hospital (11 Krivoarbatsky lane).

The last view from the house over the dome of the historic dominant of the area – the Church of the Transfiguration in Peski – was lost only in 2010 as a result of construction of a five-storey office building in the yard of house 41 in Arbat street. This view from the workshop is preserved in one of the drawings by K. Melnikov (dated July 5, 1955).

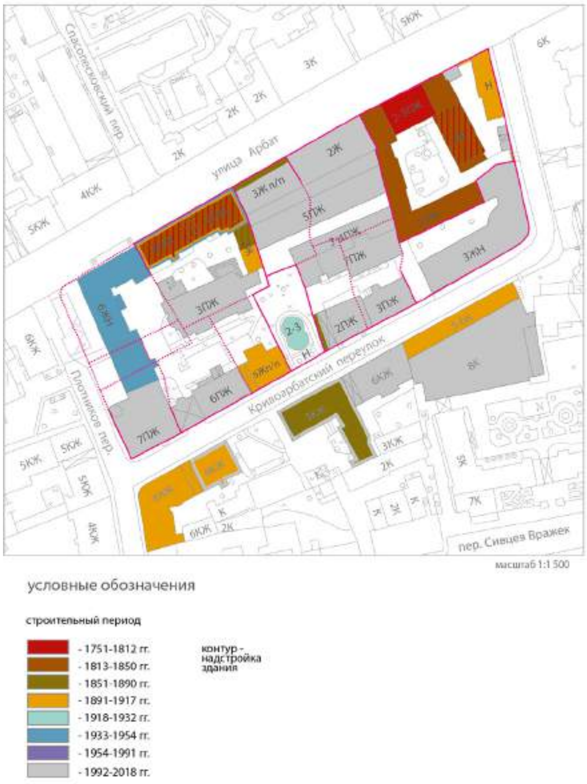
With K.S. Melnikov's thoughtful attitude to the surrounding landscape, his view on the role of the urban development environment was quite paradoxical: *'As an experiment… I asked our guests a blunt question: 'should an architect take the surroundings into account?' 'For sure!', they answered, and I baffled them proving the opposite. Bewilderment rolled away slowly like heavy fog in their heads.'* Unfortunately, the author's system of evidence of the 'opposite', that is, the uselessness of taking urban context into account has not survived and we will not be able to *'blow about the fog'* completely, but we will try to mention, at least partially, the things Melnikov ignored in his design and answer the question 'why?'.

As already mentioned above, the house was built in the depth of the plot with a margin from the boundaries, which was unusual for the development of this part of the city, where buildings were mainly located along the perimeter of the plots. Despite the fact that the architect used quite traditional methods, namely: the location almost repeated the configuration of the pre-existing building of the mid-19th century, and the arrangement of a front yard was also not uncommon to urban planning method of the Arbat buildings, – in combination, such a positioning of the building surrounded by air on all sides was quite rare.

The three-dimensional composition of the house itself, originally conceived as an experiment, did not take any of the surroundings into account and, with a high degree of probability, had to come into collision with traditional urban development. However, this did not happen due to the author's high responsibility for the results of his work: the size and proportions of the building were perfectly gauged and did not conflict with the surrounding buildings. At the same time, the author apparently did not care about the preservation of the urban landscape, but, on the contrary, considered it the future organic background of his work.

And finally, the eccentric architectural and artistic design of the building with a lot of hexagonal apertures, unparalleled anywhere in the world and disregarding the composition of the surroundings. There is a picture where the hexagon of the window opening is filled with Falconnier glass bricks used in the neighboring house built in 1912. Perhaps such a technique could create a new semantic context, linking 'the new' with 'the old', but this temptation was successfully overcome.

It can also be noted that the façade overlooking Krivoarbatsky lane is more traditional and therefore more adequate to the construction principles of the lane, but its apparent 'prudence' is undermined by the font composition with the name of the author, which is completely contrary not only to the spirit of the area, but also to the spirit of the time, which Melnikov also did not fully take into account: living in a state which abolished and nationalized all private property, Melnikov in fact built a bourgeois mansion in the center of Moscow, what he was reproached with and what his contemporaries could not forgive for many years.



Plan of the Melnikov House quarter with 18th-21st c. buildings chronology

Since the construction and commissioning of the building, the visual characteristics of the architectural monument and its immediate environment have undergone significant changes. The analysis took into account the peculiarities of the architectural environment of the district. The research used an instrumental method of constructing visibility zones of the house of K. Melnikov during two periods compared to each other: the the end of construction (1929) and the current situation (2018). The calculation of visibility zones for the initial period was performed in AutoCAD using a computer model based on cartographic materials of the 1920–1930s (scale 1:2000, 1:5000). The modern visibility zones were calculated according to the model based on the underlay of the 2000s (scale 1:2000) adjusted according to the results of on-site studies. The main factors influencing the perception conditions of the object of cultural heritage – the

Melnikov House – were elevation, building height, planning structure of the quarter, the analysis of which allowed to identify areas of optimal perception of the monument.

The change in the visual perception of the monument was analyzed in conjunction with the analysis of the preservation of the historical environment of the quarter and the degree of its transformation due to recent development.

Despite massive demolition and aggressive nature of the new development in the immediate vicinity of the monument, there are still many valuable historical buildings in the quarter and on the opposite side of Krivoarbatsky lane, such as *'Khovansky mansion, XVIII–XIX centuries'* (37/2 Arbat St.), an object of cultural heritage of federal importance; historically valuable city-defining buildings: 'The city estate of Melgunov-Makeev, early XVIII – XIX centuries, 1787, 1838, 1864' (41 Arbat St.); *'Tenement building, 1914'* (12 Krivoarbatsky lane); *'Khvostova women's gymnasium, 1910'* (15 Krivoarbatsky lane).

The houses built or remodeled in the 1930s which had great influence on the change in the visual characteristics of K. Melnikov's house now also have high historical and cultural value: *'Residential house with shops, 1934-1938, 1950'* (45/24 Arbat St.); *'Residential house with small shops, 1797, 1863, 1900, with an additional storey 1934-1935'* (43 Arbat St.).

1929

2018

Visibilty of the house and lost views from the house. 1929, 2018

Resulting from the analysis, the following conclusions have been made:

1) Despite the almost complete loss of authentic intra-quarter buildings, the visibility zone of K. Melnikov's house in the intra-quarter environment as a whole retained its original character and areal limits, with the exception of small fragments in the yards of estates 41–45 in Arbat street.

2) The visual perception track of the building from Krivoarbatsky lane is preserved completely. On the Plotnikov lane side, the visual connection with the monument is practically lost as a result of the construction of a residential building (45/24 Arbat St.); the house of K. Melnikov is partially seen from the passage arch connecting the courtyard area and Plotnikov lane.

3) The original visual perception of the building, its background characteristics have changed significantly as a result of the increase in the size of the surrounding buildings, which have been rebuilt, built up and built anew.

5) The visual connections of K. Melnikov's house with valuable historical dominants have been completely lost so far as a result of:

- demolition of the Church of St. Nicholas in Plotniki;
- construction of a large-scale polyclinic complex, which finally blocked the distant views over the Kremlin ensemble fragments;
- additional storeys of historical buildings and radical reconstruction of the neighboring property at 39-41 Arbat street blocking the view from the workshop to the dome of the Church of the Transfiguration in Peski.

5) The nature of the immediate environment of the house has changed. The perimeter of the property was originally formed by sections of a wooden fence, alternating with firewalls and blank walls of local buildings. Nowadays historically developed environment remains only in the area of adjunction to Krivoarbatsky lane: firewalls of houses № 8 (demolished and later restored) and № 12 still flank the 'front' yard of the monument. All brick buildings in the courtyard were irretrievably lost and new buildings were built in their place in the 1990-2010s. At present, the outline of the courtyard of the monument is defined by a solid wooden fence, set with an offset from the new development, which only partially corresponds to the original position.

6) Thus, radical changes in the volume-spatial and scale-stylistic characteristics of the urban environment and, as a consequence, the loss of the previously existing visual connections of the Melnikov house with valuable historical dominants that created significant points of visual perception of the urban landscape from the Melnikov house largely influenced the quality of the urban environment of the monument. But despite the mentioned changes and damage to the monument, **the house still retains a high level of compositional, architectural and artistic impact on the modern urban context of the area.**

Design and functions of the Melnikov House site

The main sources of information for this section are K. Melnikov's diary entries, oral recollections of family members, photographs from the 1920s and 1930s, paintings and graphic works by K. and V. Melnikov, materials of the restoration project of the 1990s including fixing schemes of the existing landscaping, as well as reconstruction of the functional use of the territory in the 1930s, compiled in 2005 according to the memoirs of Victor Melnikov (by Prof. Vadim Semenov).

Evolution of the Melnikov House site. 1927 - 1990

Thanks to the study of the unique records made by Melnikov in diaries and a tear-off calendar many previously unknown details on the improvement of the site have been clarified. Of great value is the study of photographs of the house during construction and in the pre-war years, drawings, paintings by the Melnikovs, which depict the house and the yard during the life of the architect. The drawings made by professional painters of the realistic movement, picturesque sketches and finished works give a fairly accurate idea of details of the site improvement: household buildings, design of fences, garden furniture, vegetation, garden path covering, etc.

The site allocated to Melnikov for the construction of the demonstrational house was an open space with two balsam poplars in the north-eastern part which are present in a number of photographs of the 1920s. Before the construction began, the area was surrounded by a wooden fence, which closed the fragments of open areas between the firewalls of neighboring houses adjacent to the boundaries.

The fence along the front of Krivoarbatsky lane was originally built as a temporary one and after the construction finished, it was replaced by a wooden fence of the author’s design with two side gates and a central gate with a wind-porch in the form of a quarter of a small cylinder jutting out into the front yard as if in anticipation of the meeting of visitors with large cylindrical forms of the demonstrational house. From the canopy covered gate visitors could call and introduce themselves with the help of an acoustic telephone: a metal pipe connecting the gate underground with the house, where there was a special receiving device (preserved to our time).

View to the House and the street fence from Krivoarbatsky Lane. Photo D. Esakov. 2016

Despite the seeming insignificance of such a construction as a street fence, K. Melnikov clearly understood its importance for the visual perception of the main building: visitors got the first impression of the house from the street. The surface of the fence was rhythmically divided into seven sections, three of which (a single gate and two double gates) are solid and made of planks, and four are semi-transparent picket fences made of timber strips set at a 10-centimeter interval. This plastic concept made it possible to overcome the monotony of the fence, which is 17.6 m long, and to emphasize the centrally-planned position of the main house. The fence was painted grayish green.

The internal sections of the original fence were preserved for a long time, until the 1990s. They must have originally been built as constant structures, especially since they did not perform a representative function. A few photographs and beautiful sketches show that their design is of a more traditional Moscow nature: straight wooden fence, at the west side on top of the fence there was a wide strip formed by boards nailed at an angle.

K. Melnikov in the southwest part of garden. 1930s

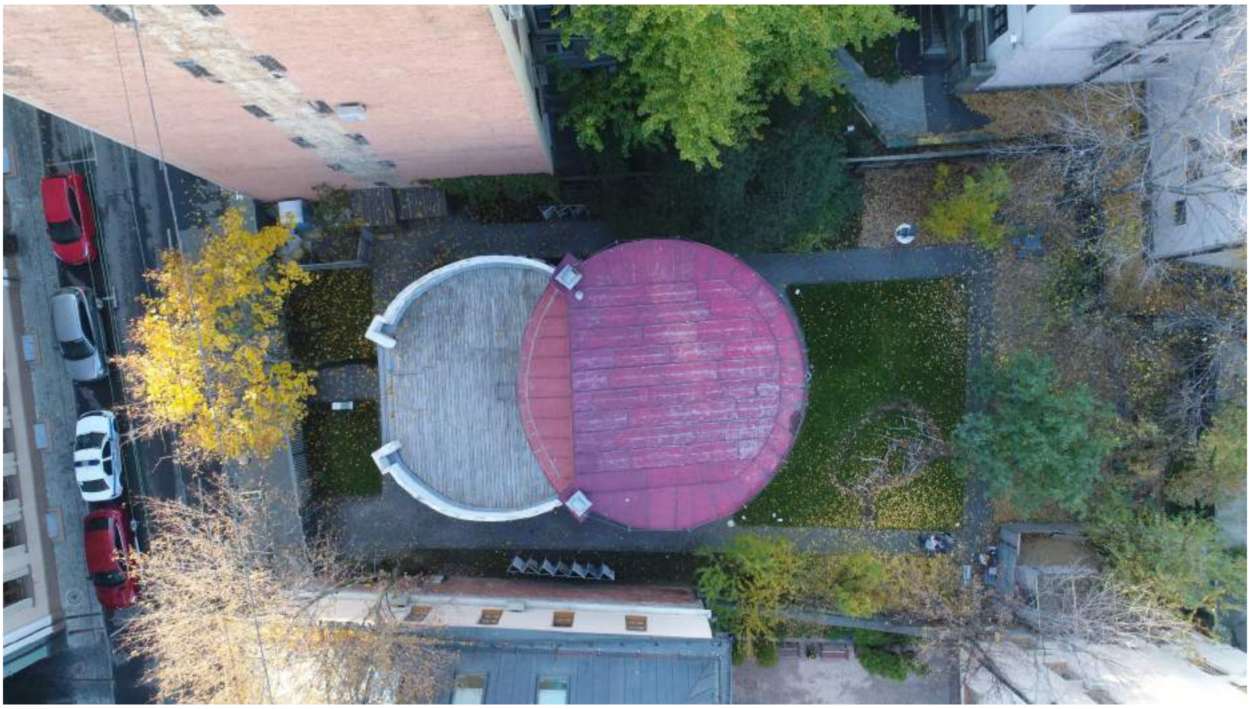
The development of the plot began after the family moved into the house in the spring of 1930. The functional purpose of the territory was formed on a practical basis. The front yard, which included the territory of future lane expansion, was planted with flowers (marigolds, dahlias, coneflowers, etc.) on the side of the house, and with lilac bushes and seedlings of white acacia on the side of the lane. In the summer the firewalls of the neighboring houses flanking the entrance area were covered with the climbing plants:

In the Melnikov House garden. 1936

beans, morning glory, more recently with wild grapes. In the photo from the 1930s Melnikov is sitting in the south-western corner of the plot at a table covered with tablecloth; the front yard may have been used for breakfast and tea in good weather.

In front of the house there was a court with three paths leading from it to the double gates and the single gate and two paths skirting the house and going into the household area of the yard. All the paths were turfed and sanded. The front yard was separated from the rest of the property on both sides by a low metal filigree fence probably intended to restrict the access of the dog guarding the house.

Just behind the house there were sports grounds for *'gorodki'* (game similar to lawn skittles) and volleyball – the Melnikovs' favorite games often mentioned in the records.



Sky view of the Melnikov House site, 2019

There were wooden benches and a table in the yard. The vegetable garden was located along the northern boundary and was basically an elongated area with a horizontal fence, adjacent to the corner of the ledge of the neighboring house on the left, and to a small household building on the right. The vegetable garden appeared on the site which used to serve for the storage of building materials in 1927-1929. In 1930 the canopy over the pit for lime hydration was partially dismantled, and it was turned into a household building – a shed for storing firewood and garden equipment. The shed can be seen in many images; its planning position was fixed in the city plan of Moscow in 1938. In the diaries of 1930, the arrangement of a semicircular earthen terrace with slopes in the corner of the plot is described in detail. Apparently, we are talking about the north-eastern corner, where there is some elevation even now, however, an image of this man-made terrace has not been found.

Reconstruction of the vegetable garden in the backyard.
Photo B. Kondakov. 2019

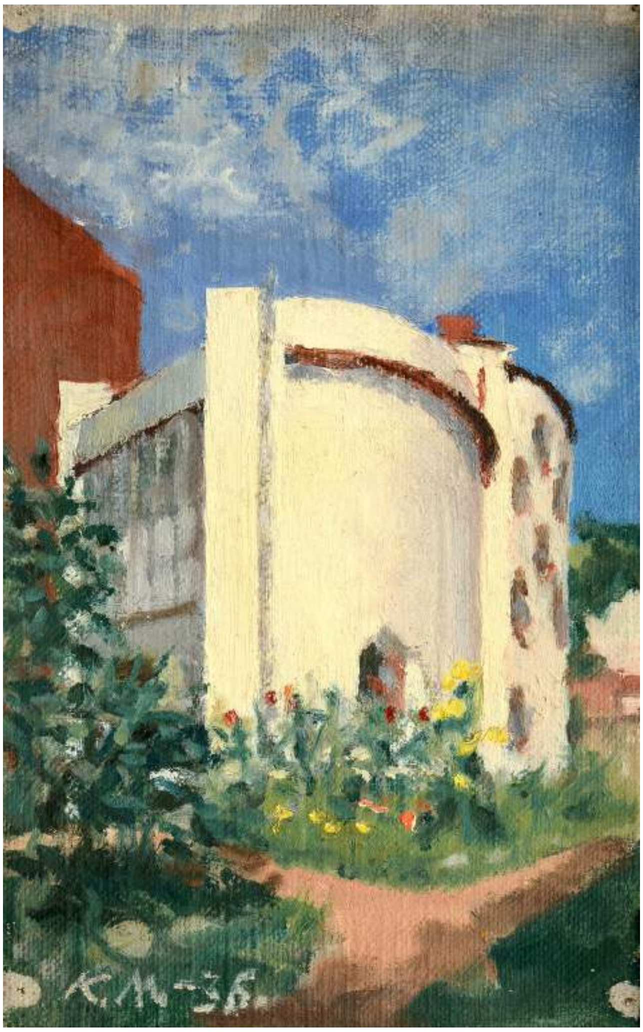
In the 1940s, the shed was dismantled and built again at the north-eastern boundary of the plot, where it is marked on the plan of 1955, drawn up by the local authorities. Refurbished from time to time, the shed stood here until the 1990s. In the documentation dated 1993, the shed is shown in a new location – in the north-eastern corner of the site, but on the plan of the existing site improvement dated 1996 it is absent and mentioned as projected. Now the shed is

K. Melnikov. Backyard of the house. 1930s restored in place of the lost building from the 1940s serving new functions of a museum shop and an info point.

From K. Melnikov's diaries of the early 1930s we know the species of trees and bushes that were originally planted on the plot. Trees: 2 pines, 3 fir-trees, 3 birches, white acacia (along the front fence), a cherry tree at the corner of the cellar (?), 2 apple trees (then more were planted). Bushes: wolfsbane, raspberry, lilac, black currant, jasmine.

Until a permanent place for the vegetable garden was prepared, in the spring of 1930 the Melnikovs made trial beds at the gate: carrots, turnips, radishes, and a little later 'built the vegetable garden' in the back (northern) part of the plot, where they planted potatoes, turnips, carrots, kidney beans, beans, cucumbers, tomatoes, parsley, lettuce, dill, radishes. The vegetable garden in the backyard was rebuilt in different versions from time to time (most recently in the early 1990s).

The nature of the territory usage has changed over time, with the predominance of mainly household functions: household activities, horticulture, sports, games, recreation. Nowadays, it serves as exhibition and lecture space of the museum.



K. Melnikov. View of the house from Krivoarbatsky Lane. 1936

Structures

The main purpose of the survey of the Melnikov House is to obtain the initial data for the preparation of a conservation project and subsequent use of the House as a museum.

The Melnikov House has been studied quite well (in particular, there is information and photos of the period of its construction), the restoration works of the 1990s are documented, and witnesses of its operation and maintenance are still alive. So far as technical side is concerned, the House has been particularly intensively studied over the past two decades, as the surrounding buildings have undergone considerable transformations at this time. For these reasons, the first stage of the survey – the analysis of the archival documents – provided a great deal of information on the structures of the building, changes of their condition over time and, accordingly, specified the program of survey.

Preliminary documental and archival analysis of structures

A total of more than 40 archival sources were analyzed, some of them are multi-volume. Some of the sources have been studied for the first time because they have been recently digitalized by the State Museum of Konstantin and Viktor Melnikov (for example, Melnikov's diaries of the construction period, Melnikov's drafts, the materials on restoration of the 1990s) – thus, in this work, for the first time the available documentation on the building has been analyzed to the fullest extent.

The most objective source is photographs of different years. The second most important source is Melnikov's diary entries in the tear-off calendar of 1927 – 1930. Almost all other materials demand cross-analysis, since they may contain part of authors' personal interest – especially it relates to documents over the past few decades, when there were disputes about buildings surrounding the Melnikov House. Of the relatively recent documents, the documents on the restoration of the 1980s – 1990s turned out to be the most useful – detailed information about the structures, opened during construction works and newly constructed or restored during the restoration, can be found there.

As a result of the documentary analysis, the following conclusions were made:

1) Analysis of the photos of the construction period (1927-1929) and initial operation of the house in the 1930s, Melnikov's diaries allow to point to the following features of the building:

K. Melnikov and his wife Anna at the house during construction. View from the southeast. 1927

- The brickwork structure with the shifting of courses according to Melnikov's system is clearly visible. The internal walls are carried out in "raked joint" type of brickwork, its quality is low, head joints are too thick in places, there are some broken bricks as well, brickwork deviations are seen in places what is compensated by reduction of bed joints width of the upper courses of brick – but it should be mentioned, that the brickwork was made for the further application of plaster, which was known already by Melnikov and probably bricklayers.
- Across the perimeter, damp-proof layer of tar paper is easily seen between the upper layer of the rubble foundation and the brick masonry.
- In the lower part of the second level of openings there is a well-marked brickwork of the internal cornice, on which the floor joists of the ground floor will be laid. It is laid out along with the brickwork of the walls.

1.1) Melnikov was building his house really experimental not only in terms of architectural, but also in terms of constructive solutions, not knowing in advance how structures and structural connections designed by him would behave. It also refers to masonry, membrane-structured floor joists and joint work of joists with partitions. In many ways, he acted intuitively. During construction, Melnikov repeatedly corrected his decisions «on site» regarding the basement construction, depth of the foundation, material for filling the hexagonal apertures, doubts about possible deflection of the roof sheathing and designing of a roof truss, changes in the design of the roof of the small cylinder, installation of an unplanned window in the living room. Evidence of this are, for example, handwritten notes by Melnikov dated November 22 – 25, 1927:

22 'Nov. Finally! Installation of the ceiling joists is over; settlement is 14 mm (from wedges).

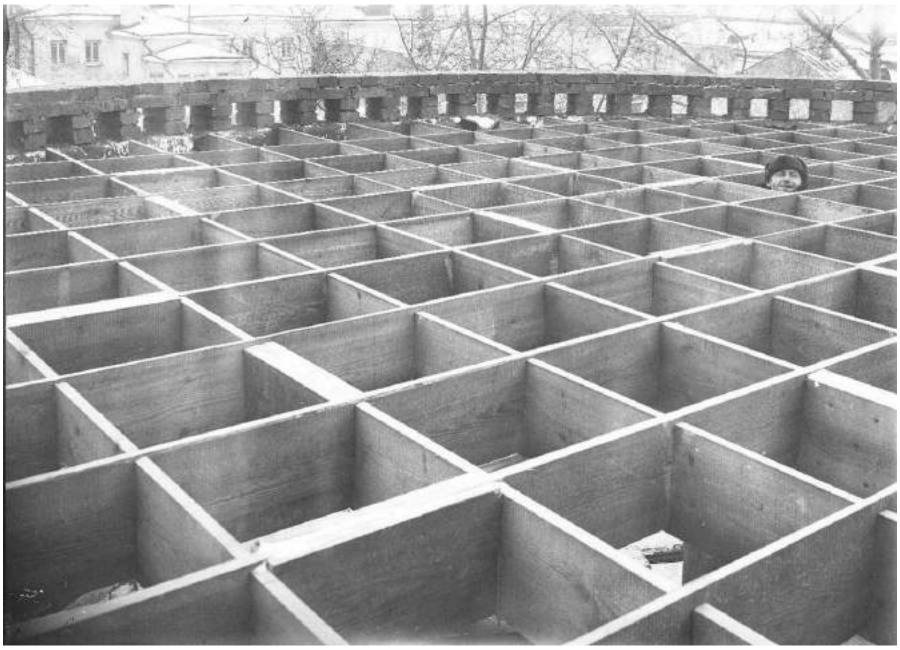
24 Nov. Still afraid to remove the scaffolding from the side of the first cylinder.

25 Nov. I decided to install a roof truss because the settlement of the circle is obvious.'

By the roof truss Melnikov means a partition between the attic floor joists of the large cylinder and the roof of the small cylinder – diagonal braces are inserted between top and bottom chords of the partition wall.

1.2) The construction process was far from ideal. The material was often of low quality (some extracts from the architect's diary prove that he repeatedly sent materials back), workers were not always qualified as well. Melnikov had to compromise between his artistic conception and technological capabilities of his time. It was also important to reach a compromise, considering the artistic conception, durability requirements and convenient house operation. As an artist, Melnikov often chose in favour of the artistic conception – for example, leaving the exterior walls without protection of window drip caps and the terrace parapet without any protection, which inevitably leads to more frequent repairs.

1.3) Difficulties with financing of the works caused a serious delay in construction (from 1927 to 1929) involving many other problems – the necessity to install a temporary roof and repair it, the temporary



Membrane-type roof structure of the large cylinder.
View to the northeast. 1928

- In the near future, some hexagonal apertures will be filled, and some will disappear, as the brickwork will be removed almost up to the level of the attic joists. In this photo the top of the wall has not been slopped yet, repeating the roof slop of the large cylinder. A significant part of the visible brickwork above the ceiling joists will be mostly (or even completely) rebuilt.

- Rim joists around the perimeter of the membrane structure are not set yet – probably, they were made on site, unlike the wooden grid (ceiling joists) that was made in advance. The ribs of the grid are laid on a layer of tar paper. Another layer of tar paper is laid on top of the grid, attic vents are between these two layers.

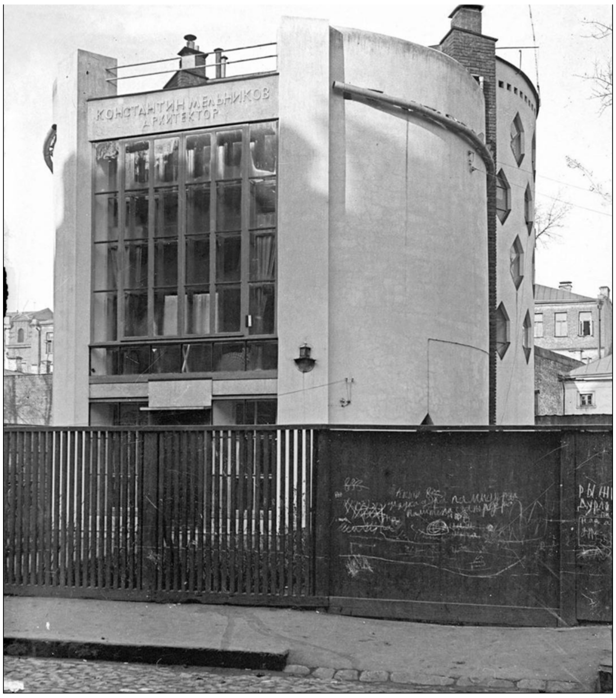
- The height of the joists slightly differs. The depth of joists notches differs too. As a result, both, the lower and the upper surfaces of the grid are not on the same level – consequently, when covering the grid with wood planks below and above (attic grid – only below) some nailed butt joints will not be strong, that is some grid ribs and the wood planks will not be firmly fastened, which increases their weakness unpredictably.

- Some joists have wanes and even bark.

roof leaks, realization of particular types of work in adverse weather conditions. Roof leaks, wetting of wood structures could have caused their additional deformations and even then, become contributing factors in progression of wood destruction processes. Wetting of the masonry and its defrosting, wetting of plaster layers could have led to cracks and deformations of the walls in the following decades.

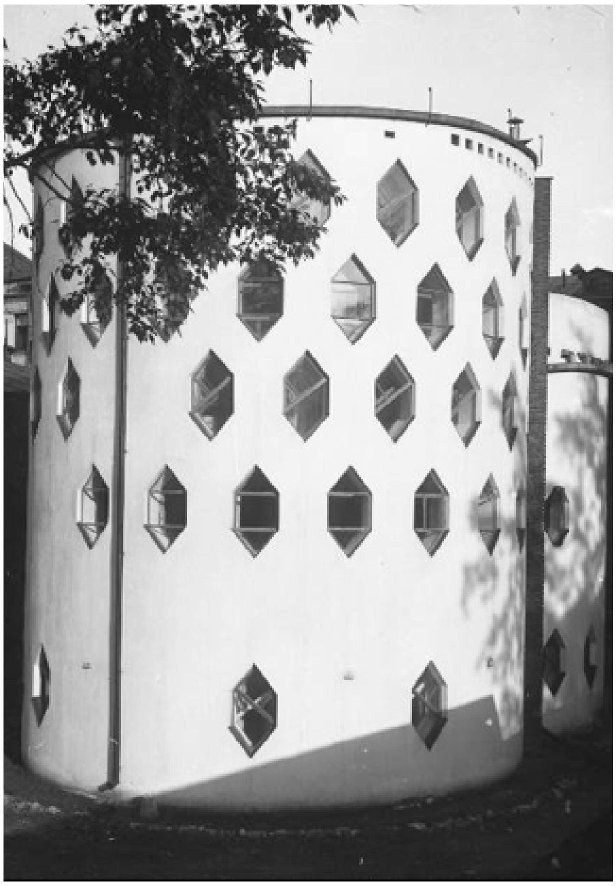
1.4) As an aside, it is worth mentioning that, emphasizing the fact that his floor joists were not supported by intermediate supports (supporting columns, beams), K. Melnikov could initially expect that internal partitions would function as supporting (unloading) as in many buildings of pre-revolutionary period, where they were involved in elastic work of floor joists (including other floor joists) for bearing live (temporary) loads. The chronology of their installation points to this fact as stated in the diaries.

1.5) Melnikov accepted philosophically deformations and cracks that appeared during adaptation period of the structures, he did not strive to remedy them immediately. The cracks in the Melnikov House were from the very beginning of its operation, moreover they were not only on wood structures, but also on brick walls of the building.

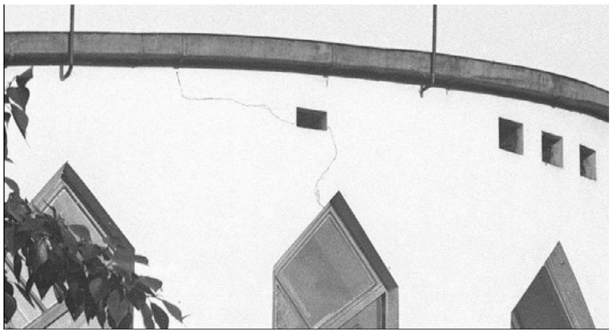


View of the House from the street. 1930

- The façade of the building is covered with a network of shrinkage, humidity and temperature-induced cracks.
- There are water stains on the façade under metal windowsills – probably because the metal sills do not project out enough over the wall, and their acute angle shape is not optimal. In general, it should be noted that the house tended toward this defect from the very beginning.
- There is a water stain on the façade, where the gutter is connected to the downspout – water misses the downspout and leaks down the wall.
- Vertical cracks intersect the inscription «Konstantin Melnikov Architect.» Interesting fact is that now they are almost in the same places.
- Dark stains of the exterior wall finish on the edge of the parapet. This initial defect is a consequence of the constant impact of precipitation (rain, snow) on the unprotected surface of the parapet.



The northwest façade. 1930s



Enlarged fragment of the photo of the northwest façade. 1930s

There is a diagonal crack on the façade that goes from the roof level through the attic vent to the upper corner of the window. Nowadays, it also exists and it is continuous.

Thus, it is possible to point out the preconditions for the occurrence of defects and deformations of the House structures, which lie in his history (imperfect technology, materials, workers' qualifications, constructive solutions owing to lack of funds), and register their regular occurrence and development over time. Moving forward a little, the continuity of deformations is obvious, cracks appear after repairs in the same places throughout the history of the House.

Konstantin Melnikov and his dog at the west façade. 1950s

Physical deterioration of the building had been accumulating over the years. Finishing layers cracked, detached, crumbled (especially near the downspouts and on the foundation, and in this case, near the doghouse). The vegetation grew thicker, wet the façade, not allowing it to dry, the trees littered the downspouts and the roof with leaves. Without maintenance physical wear accelerated.

2) The period from the 1930s to the 1950s is less documented. However, there are the Melnikovs' memories of a significant worsening of the condition of the House during the war. This is indirectly indicated by the amount and nature of the repair activities of the 1950s. Physical wear sharply accelerated. At this period of time it is already possible to talk about moisture damage to the wood structures of the floor joists and coatings, which increased their deformation and led to the load redistribution on partitions. The removal of two partitions of the ground floor also contributed to it. It is important to mention that the House was connected to district heating system in the late 1950s, as a result of the reconstruction of the heating system. Because of this the owners of the House lost the ability to regulate temperature and humidity conditions off the heating season. In the course of time it became harder to maintain the House. For the sake of preserving the House (and simply for the sake of preserving the possibility of living in it) Konstantin Melnikov, and later his son Victor Melnikov, compromised and agreed to change the roof and then repair the façades of the building.

3) The period of restoration of the House began from 1982. But financial problems repeatedly brought to a halt of restoration works. Protraction of the restoration created prerequisites for the worsening of its condition and occurrence of future problems. The restoration revealed the real state of the House and its problems, returned the originally designed roofs and the finishing layers (close to the original in color and texture) to the building, restored the layout of the ground floor. It also eliminated lots of problems related to structural damage because of rot and wood-decay fungi, local deformations, but mostly removed the original construction of the roof of the large cylinder, slightly changing its elements. The restoration changed the design of the support for both floors and partitions of the ground floor, partially replaced and changed the original finishing layers for identical ones.

Solving old problems, the restoration of the 1990s laid the foundation for some new ones (deformation of the plaster layer of the ground floor ceiling because of jacking up of the floor joists, settlement of fresh foundations of partitions, installation of inclined concrete base under the wooden floors in the bathroom without a drain, rather thin floor wooden planks on the ground floor, etc.). For the sake of preserving the original material, the restoration left the current state unchanged (significant deformations of the floor joists, bearing role of the partitions, laying rigid foundations under the partitions of the ground floor). Another option would have removed a significant part of the original structures and it is unknown how it would have ended because of funding problems.

4) After the official acceptance of the restoration work in 1997, in the late 1990s and early 2000s, fulfilment of unfinished works still continued: the blind area, the grading, and utility networks were not completed. However, new defects in the finishing layers inside and outside the building began to occur, they were most fully recorded in the report in 2002 and later in 2006. Additionally, in these years (and even a little earlier – from 1994) the adjacent territory began to develop (superstructures or construction after the complete demolition of old buildings – moreover, all of them with developed underground parts) and the question of the associated geological risks came to the fore. Local surface subsidence was documented on the surrounding territory and on the plot of the Melnikov House. At the same time, deformations were developing and defects appearing in the structures of the Melnikov House. To control the deformations of the building since 1999 survey markers has been installed in the building and geodetic monitoring has been carried out periodically. The maximum settlement, detected from 1999 to 2006, was 5.3 mm. The side, that defended the interests of the Melnikov House, made arguments, supported by documents, and insisted on the damaging impact of construction on the structures of the Melnikov House and related risks for the monument. The opposite side (developers) made counter-arguments and managed to finish the construction over time. Adverse impact of the construction, including underground level parts, on the surrounding buildings is indisputable, but now after the construction is completed, it is late to analyze this influence, it is only sensible to make sure that the settlement of the building has stabilized and to help minimize the damage from the constructed buildings.

Fragment of the living room. 1981

All the characteristic damage inside the building is clearly visible, which is to a certain extent noticeable nowadays and was evident during the operation of the House. These are cracks in the plaster layers of walls and ceilings, reflecting movements of the wood structures of the floor joists and partitions relatively to stone walls and each other, as well as deformations of the wood structures.

Restoration of façades. 1996

During those years, several technical conclusions were drawn based on a survey of the building with contradictory information, ambiguous conclusions and recommendations (1996, 2002, 2006).

Work program and its implementation

Based on the results of the analysis of all accumulated materials and experts' opinions, preliminary conclusions about the structures of the building were reached and priorities in the survey program were established:

1) The program of geological and hydrogeological survey ought to give answers to all questions and put an end to disputes about external dangers to the Melnikov House, that is to be as detailed as possible and, as to the volume of work, be no less than previous detailed survey of 2006.

2) Since geodetic monitoring was previously carried out, and old survey markers remained on the building, it is advisable to use the old markers and continue the observation cycles.

3) In order to define more exactly the change of the structure and the state of the foundations, the soils under the footings and the blind area it is necessary to dig some pits. It is permissible to use the results of 2006 when analyzing the foundations and soils of the foundation. It is allowable to use the results of 2006 when analyzing the foundations and soils under the footings.

4) In the process of visual inspection, visual evidence of the state of the structures of the House should be obtained in the most detailed way both inside and outside the building (graphically and with the help of photography).

5) To minimize the harm and the number of openings, the most non-destructive methods should be used. The winter period allows thermal imaging in order to assess the structures and possible latent defects. The endoscope and mini-cameras should also be used for the research in accessible places.

6) Structural openings were not conducted after the restoration of the 1990s. In the 1990s, a quite limited number of openings were performed in few places. Therefore, despite the wishes of the Museum and complexity of performing the openings, it is necessary to carry out the maximum number of them. During the process of making openings it is necessary to consider the wishes of mycologists and materials specialists, use all the openings together and provide the most complete description of them. Any opening must be justified, including in terms of the possibility of opening the structures and subsequent painless filling in.

7) There are discrepancies between the restoration data of the 1990s and subsequent surveys regarding the roof structures of the large cylinder. Since calculations of the supporting structures are planned as part of the inspection, a comprehensive examination of structures from the attic and through the vents from the northern façade (using a tower) is required.

8) Opening of the roof of the small cylinder involves a high risk. The roof was made during the restoration of the 1990s and is described in detail. The amount of information about its structures is sufficient. The condition of the wooden elements is planned to be inspected from outside the vents (using a tower).

9) The visual inspection revealed the presence of defects and damages in the upper part of the walls, which needed to be examined and, if possible, opened – an examination of the façade from the tower was required.

10) Considering the complexity of the intermediate floor structures and a large number of defects (already clearly seen on photographs of the 1930s and 1990s), theoretical calculation of the floor joists and coatings in terms of approaching the actual operation of structures with allowable accuracy can be considered impossible. The only way to assess the actual rigidity and strength of the structures may be to test each intermediate floor with a test load, placing the load in vulnerable places. Since the function of the building changed to a museum, it should be taken into consideration that the

load involves the movement of excursion groups. It can be said in advance that the structures will not be able to bear the live load for a museum, evenly distributed over the area (400 kg / sq m) – probably, as well as the live load for a residential building (150 kg / sq m), distributed over the entire area. Therefore, in addition to assessing the actual work of the floor joist structures themselves, the real distribution of loads applied to them should be taken into account – this is the only way not to condemn the entire building to reinforcement of structures (which would be formal and unjustified given the real loads on floor joists). The museum function of the building allows to detect zones with the constant presence of certain loads (exhibits), which implies the absence of live loads from tour groups there.

The specification of priorities in the survey program distinguishes this work from all previous studies of the Melnikov House.

In the process of surveying the constructions, the following works were performed:

- Study of archival materials.
- Inspection of foundations and layers of clay blind area and filled-up soils in three pits.
- Visual inspection (defectoscopy) of the façades and the interior rooms of the building, photographing, selective measured drawings.
- Defectoscopy of walls, partitions, floor joists/coatings, floors. Photographing, selective measured drawings.
- Survey of the roofs of the large and small cylinders. Infrared thermography (IRT), defect detection, photographing, selective measured drawings.
- Visual inspection of the rafter system and the attic joists of the large cylinder. Selective measured drawings, photographing, sampling of insulation.
- Visual inspection of intermediate floors using endoscopes and portable cameras.
- Openings and visual inspection of the inner structures of the building – 33 openings, outside the building – 20 openings. Selection of sections and conditions of structural elements and materials, sampling of materials, photographing.
- Determination of structural robustness and moisture analysis of building materials using nondestructive testing (NDT).
- Checking calculations with the three-dimensional design modelling of the building with the subsequent correction of calculations based on the results of field tests.
- A report of the survey results was compiled with checking calculations, assessment of the technical condition and recommendations for elimination of defects and further operation of the house.

At the same time, research of the following aspects was performed: building and finishing materials, mycology, geology and inspection of utility networks (hot and cold water supply, sewage, drainage systems, acoustic telephone). During the inspection of utility networks, the following works were performed:

- determination of the type of utilities and their elements;
- identification of connection points to external networks;
- technical drawings;
- detection of defects, damaged elements, malfunctions, photographing;
- quantitative analysis of the physical wear of the utility networks;
- analysis of the survey results, assessment of the technical condition of the utility networks;
- development of recommendations for repair and restoration.

Defect detection: visual inspection

During the visual inspection in February - March 2018, all visible cracks and damage to the building were documented graphically and with the help of photography, and a detailed inventory of them was prepared.

A total of 72 defects were identified: 21 – outside, 44 – inside, 7 – on the roof and terrace.

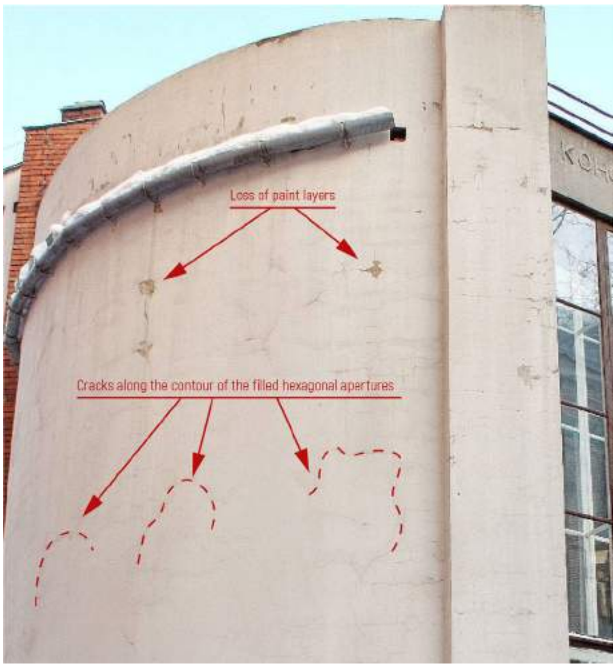
Defects of the façades

Defects of the façades are diverse – there are numerous cracks, paint and plaster damage, corrosion of the metal parts, etc.

They include in particular:

- Hairline cracks up to 0.1 mm across the entire surface of the façades, including cracks along the contour of the hexagonal apertures filled during construction of the house.
- The cracks in the glazing of the large window reflect deformations of its frames – warping and bending outwards.
- Vertical and near vertical cracks in the façade inscription "Konstantin Melnikov Architect" up to 0.2 mm wide. Presumably initially caused by stress, increased by weathering. There are also cracks in places where the inscription adjoins the walls of the terrace.
- Slightly more noticeable cracks up to 0.2 mm wide are on the north façade above the window of the first floor and near the ground floor window. These cracks may be attributed to settlement cracks.
- Water stains under windowsills of all hexagonal windows. Consequently, the presence of more noticeable cracks there and a slight weakening of the plaster under the windowsills.
- Wetting and dirtying of the plaster layer, mainly in the foundation of the building. The layer is made of cement-sand mortar, it is moistened more than other parts of the building and in winter the plaster comes in contact with snow (defrosts).
- Diagonal crack up to 0.3 mm wide stretches out from the top of the upper window to the attic vent and further to the roof (the northwest façade). Inspection from inside the building showed that it is a through-wall crack. Originally it resulted from stress, afterwards it could expand from settlements (however, similar deformations were not found below this crack, it is just barely possible to point to a concentration of cracks 0.1 mm wide near that place).

Through-wall diagonal crack 0.3 mm wide. Northwest façade.

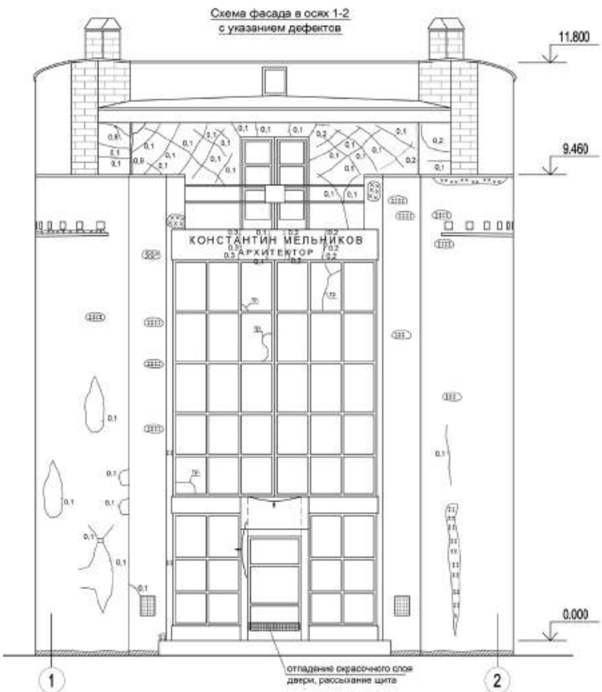


Cracks in the southwest façade of the building.

Water stains under windowsills, cracks, damage to the finish, traces of repairs. It is clearly visible that exterior windowsills differ in shape and width of their projection

Debonding of the plaster layer from the base, its loss – near the downspout. Water stains and damage to the finish under the windowsills. Corrosion of the roof vertical projection

Damage to the masonry of the terrace walls owing to defrosting, loss of the plaster layer



Defects of the south façade

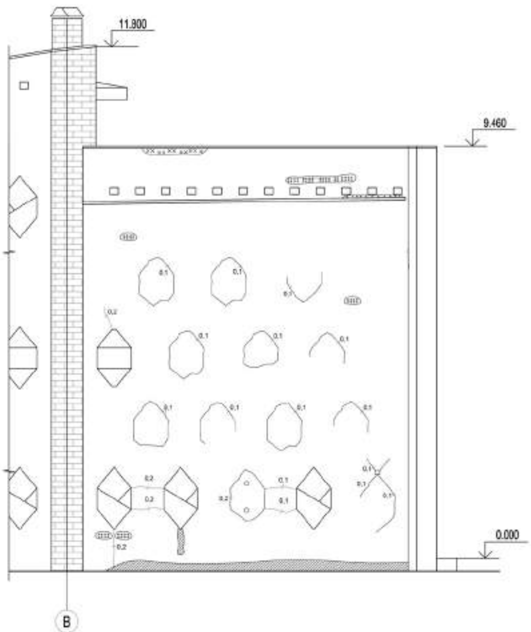
Crack in the façade inscription

Cracks in the porch. Chinks and paint damage, warp of the entrance door boards

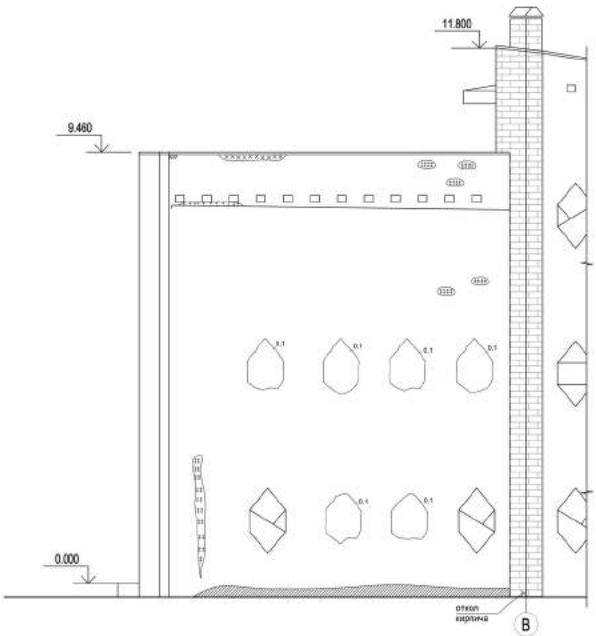
The roof of the large cylinder

Water stagnation on the roof surface in two places near the edge and near the downspout of the northern façade. The reason is sagging of the spaced sheathing and roof structures.

Roof of the large cylinder. Traces of water stagnation near the downspout. Paint damage



Defects of the west façade. South cylinder



Defects of the east façade. South cylinder

Defects inside the building

Basement

On the west and east exterior walls of the basement there are efflorescences. At the beginning of the inspection (February – March 2018), during the heating season, the walls had a dry surface. Efflorescences destroy masonry of the basement. Every day, traces of crumbling wall material (mortar and stone) were recorded on adjoining surfaces. After turning off the heating (April 2018), the surface of the exterior walls of the basement became wet and cool. The interior walls of the basement do not have such damage. Presumably the process is related to the humidity of the soil which is in contact with the wall from the outside.

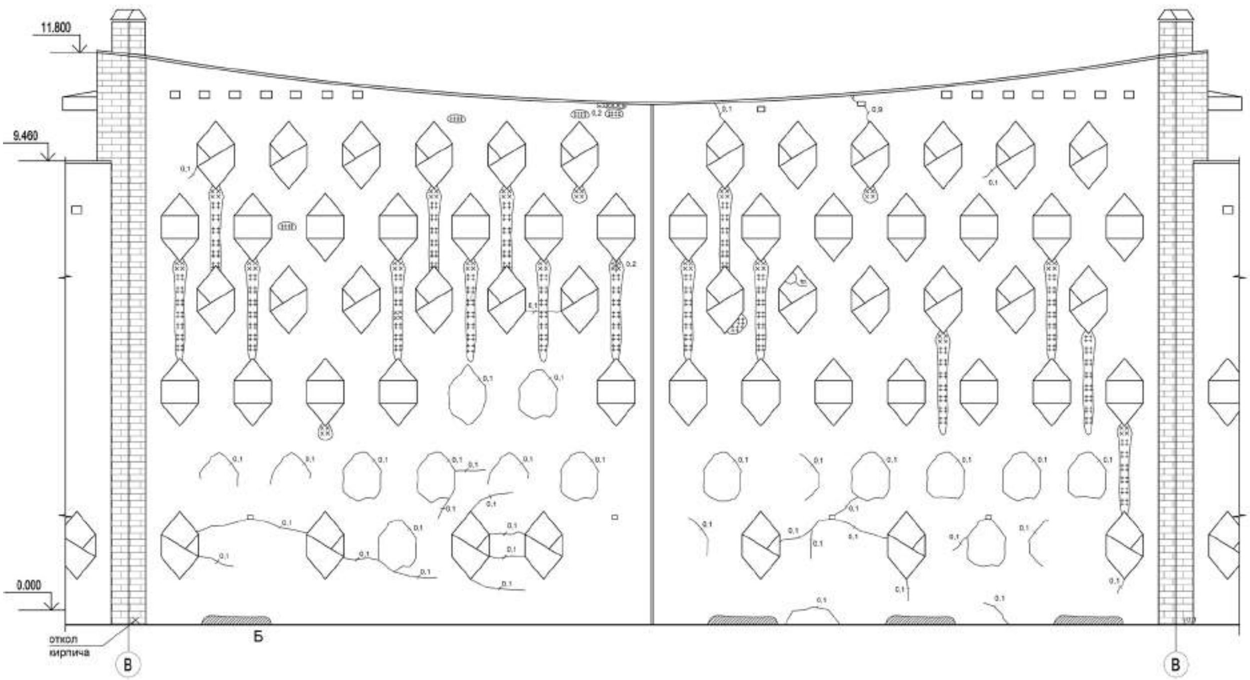
Surface of the exterior walls of the basement. Traces of efflorescence on masonry

Crack in the brick wall of the basement, the wall remained from the former building. The crack width is 2.5 – 3 mm, it continues on the floor joists up to 2.5 mm wide between a joist and reinforced concrete filling

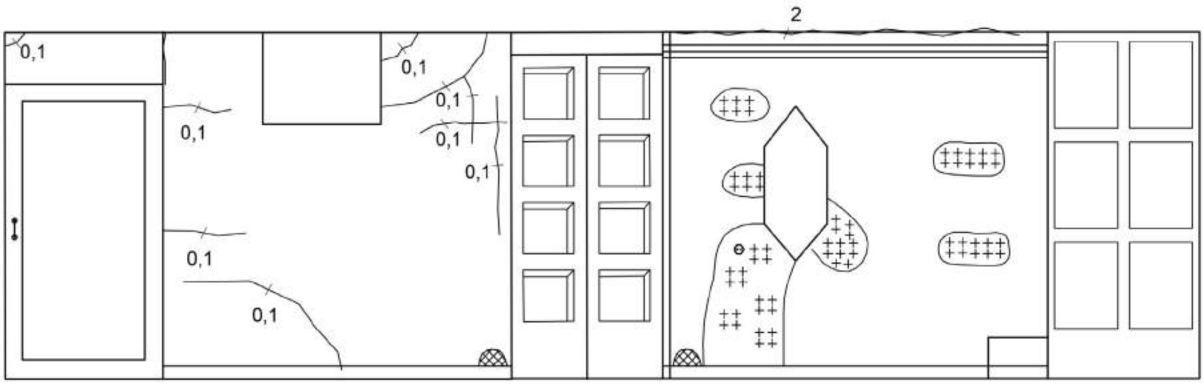
The ground floor. Common defects

· The wood surface of the floors is quite flexible, there are local damages. Instability, sagging of the floors when walking.

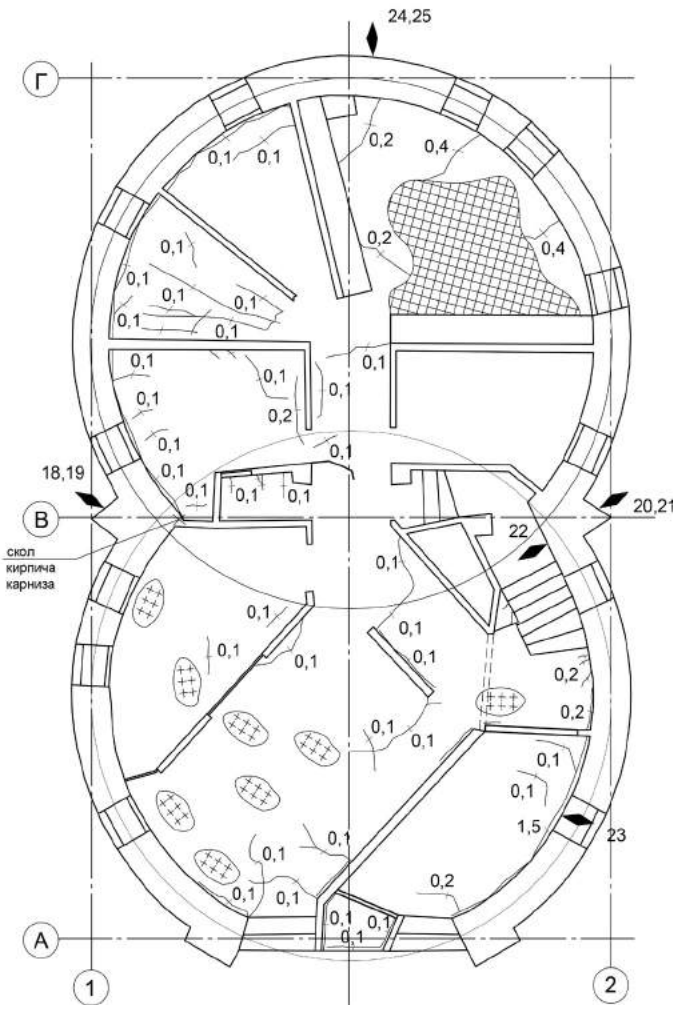
· Loss of paint, cracks in the finishing layers, in floors and ceiling. Deformations and cracks in wooden doors and windows



Defects of the façade. North cylinder



Defects of the walls. Lobby. Ground floor

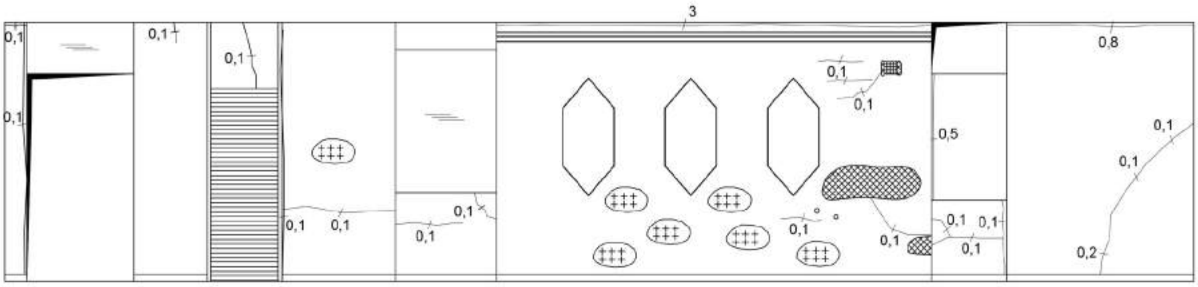


Defects of the intermediate floor. Ground floor plan

The ground floor. The staircase and part of the corridor in front of it

Cracks in the plaster layer of the wooden partition and ceiling

Physical deterioration of the stairs, there is a crack where the string meets the wall. Dirtying and loss of plaster layer



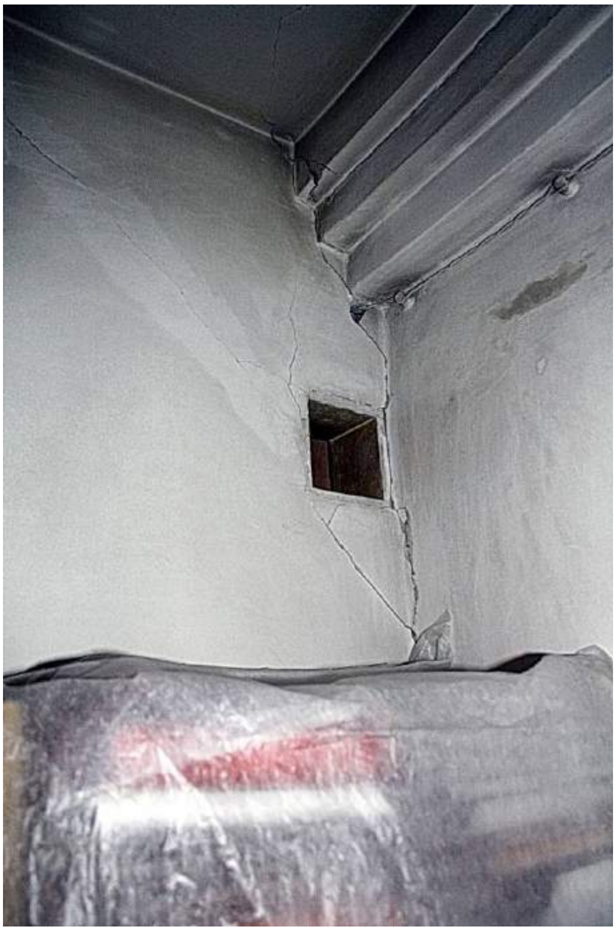
Defects of the walls. Kitchen. Ground floor

The ground floor. The corridor

Cracks in the finishing layers of wooden partitions of considerable width, up to 2 mm. Their presence is observed on the large cylinder. They are oblique in orientation, have a settlement character, probably originated from the settlement of the foundations of partitions. The direction of the cracks indicates the deformation of the partitions towards the center of the large cylinder.

Settlement cracks in the partitions of the corridor of the large cylinder

The ground floor. Daughter's room.



Cracks in the partition and where the partition meets the exterior wall

The ground floor (dressing room)

Falling away of the plaster layer from the ceiling with the exposure of lath and bast fiber fabric, which cover the bottom of the floor joists. It is about 50% of the ceiling surface of the room. As a result, the cracks in the ceiling finish have a much larger width than in other rooms (0.2-0.4 mm).

Falling away of the plaster layer from the ceiling, cracks in the rest parts

Diagonal cracks in the semicircular partition of the bedroom

The first floor. Bedroom

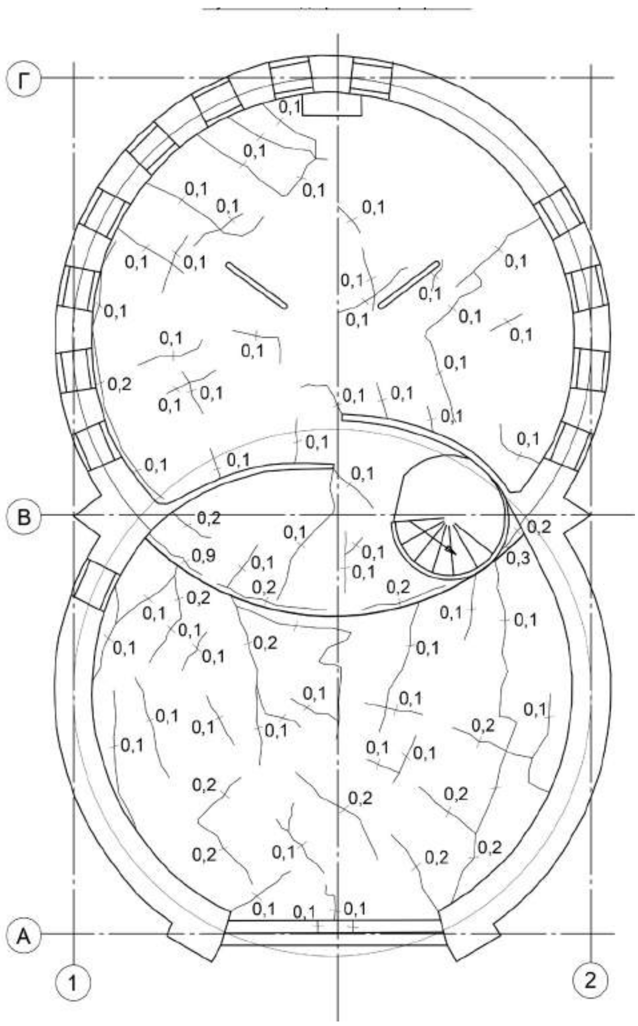
The bedroom floor boards are overdried, lost joints: their tongues came out of grooves. In some places the width of chinks between the boards exceeds the size of a ridge (tongue).

There are large local sags in boards of the bedroom floor, as they are not joined any more.

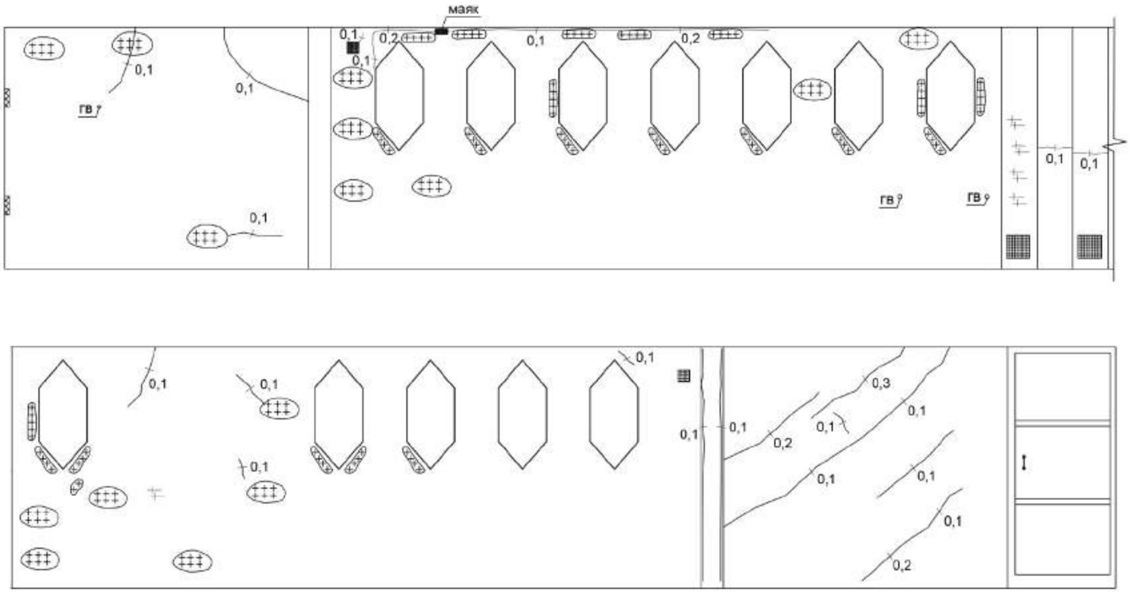
Moreover, the bedroom floor has a large common sag, that reflects the deformation of the entire intermediate floor including the ground floor partitions.

The first floor (living room)

- Cracks in the ceiling finish of the large cylinder projection, mostly up to 0.1 mm wide.
- Cracks in the brick wall near the places of applied concentrated load up to 0.3 mm wide under the support of the lintel of the large window and 0.2 – 0.3 mm near the supports of the truss.
- Cracks in the glazing of the large window. More serious damage to wooden frame elements, loosening of wood surface fibers, in some places there is rot.
- Ceiling sagging reaches 100 mm.



Defects of the intermediate floor. 1st floor plan

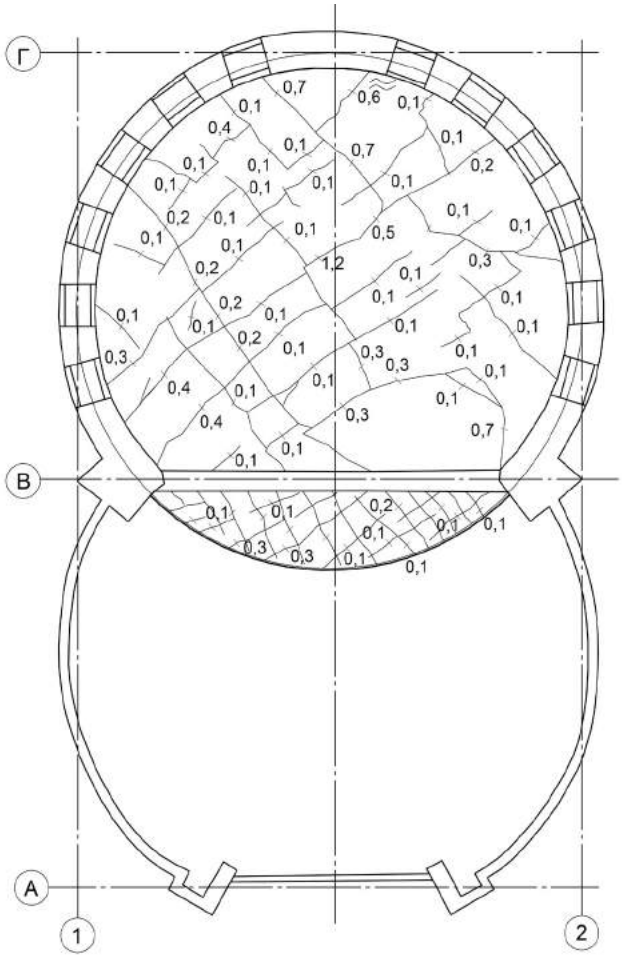


Defects of the walls. Bedroom. 1st floor

The second floor (studio)

Sagging of the studio ceiling reaches 80 mm.

Condensation in the gap between the frames in the studio. Destruction of the finishing layers of the frames and the walls between the frames



Defects of the intermediate floor. Studio. 2nd floor plan

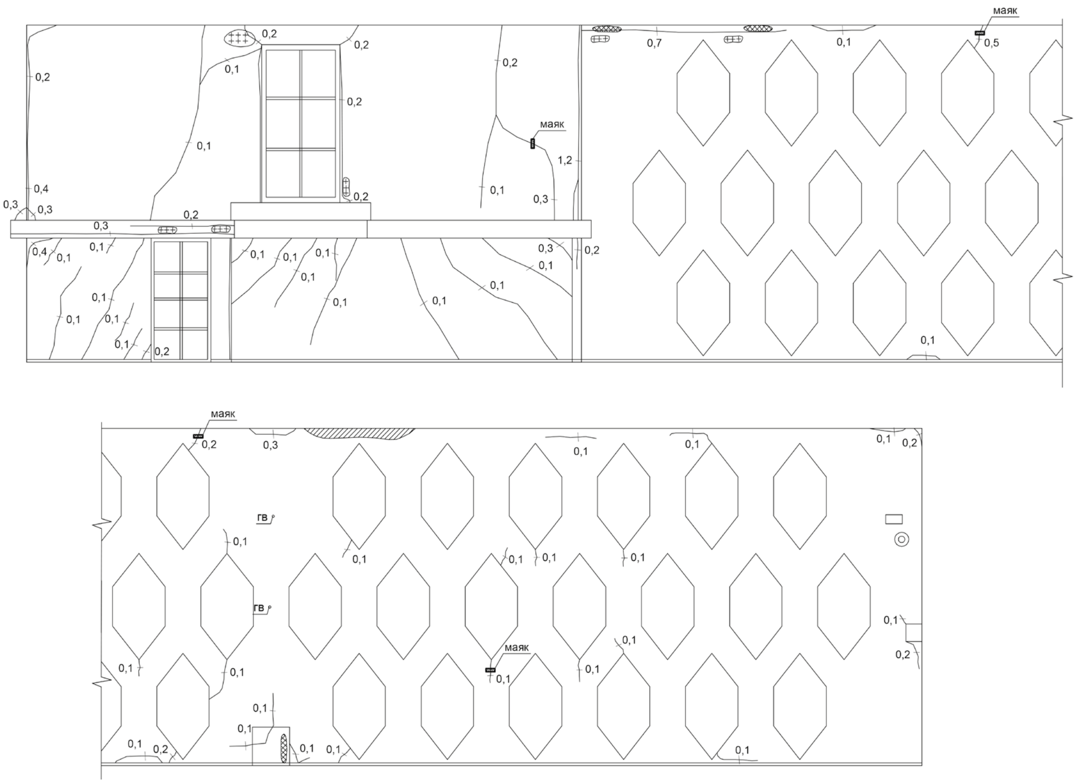
Through-wall diagonal crack under the upper window of the studio. Northwest wall

Conclusions:

· There are only few cracks in the building that can be attributed to settlement cracks – in the west façade of the small and the large cylinders. At the same time their width is minimal. The most pronounced through-wall crack initially occurred under stress and is visible in the photographs of the early 1930s.

· The most pronounced defects (cracks in partitions and ceilings) are associated with insufficient rigidity of wooden floors and settlements of the load-bearing partitions of the ground floor built on reinforced concrete foundations in the 1990s.

· Comparing the results with the materials of defect detection of 2013, the stability of deformations and the absence of any significant new defects can be definitely indicated. Nowadays some cracks are even less opened than in 2013, which can be explained by local repairs and measurement errors.



Defects of the walls. Studio. 2nd floor

Geotechnical survey and condition of foundations

Foundations

In December 2017 – February 2018 the foundations in three pits outside the building along the northwest, the east and the southeast façade were examined. The data on four pits from the 2006 report was also analyzed. These seven points cover almost the entire perimeter of the house and provide a reasonably comprehensive picture of the structure and condition of the foundations. Furthermore, archival materials about the foundations, constructed during the restoration work in the 1990s under the internal walls of the ground floor, were used: they were measured in the process of the ground floor openings. While digging, groundwater was not found. The water table is significantly lower than the footing of the foundations: in the process of drilling it was detected that a perched water table occurred at a depth of 7.5 – 8.2 m.

The foundations of the exterior walls (constructed in 1927) are strip ones, made of ashlar and rubble limestone (with sandstone inclusions) on a complex mortar, and the lower part is partially made of crushed stone and brick. The foundations have one or two footings.

The strip foundations of the internal walls in the basement of the 19th century, made of red brick on a complex mortar, in places rest on an ashlar limestone masonry.

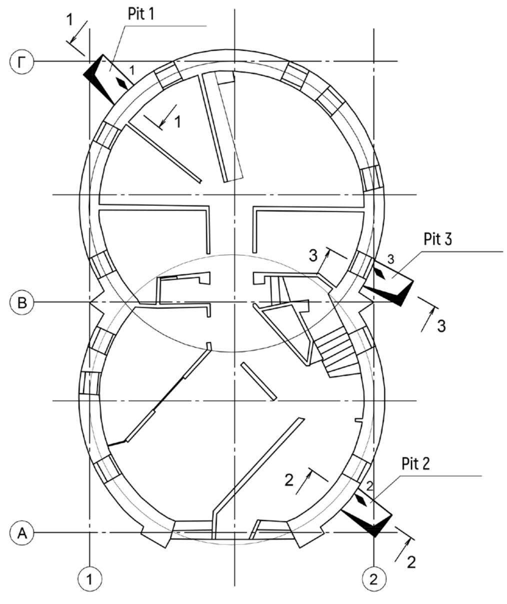
The foundations under the partitions of the ground floor (constructed in 1996) are monolithic reinforced concrete strips on a layer of sand cushion that was poured into the trench, dug in filled-up soil.

One of the important discoveries, made during the survey, is the uneven depth of the foundations, not only between the cylinders, but also within a single cylinder. The depth ranges from 2.42 m to 3.5 m from the ground level for the pits dug in 2018 and from 1.44

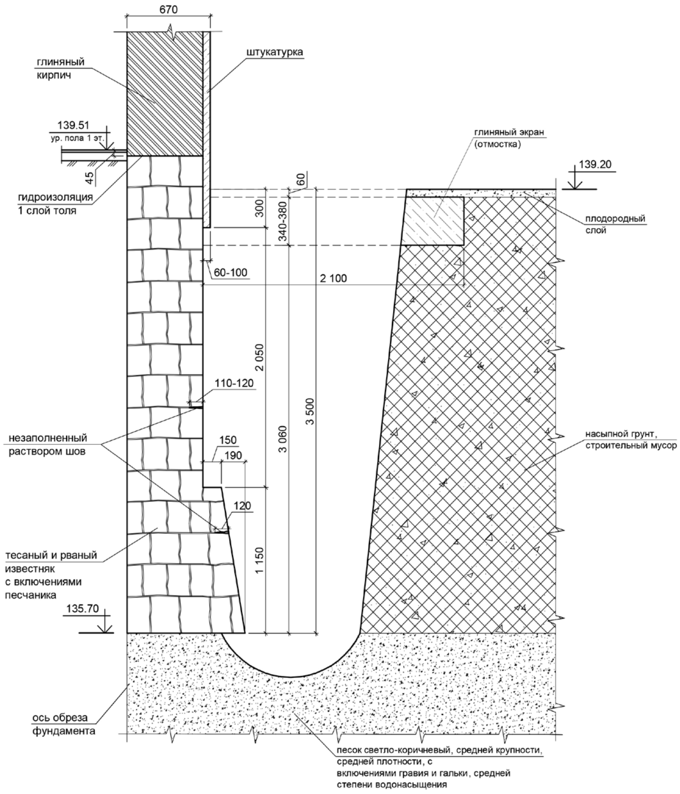
Pit 1. Lower footing. A chisel points out depth of the washed out mortar

Pit 2. Lower footing

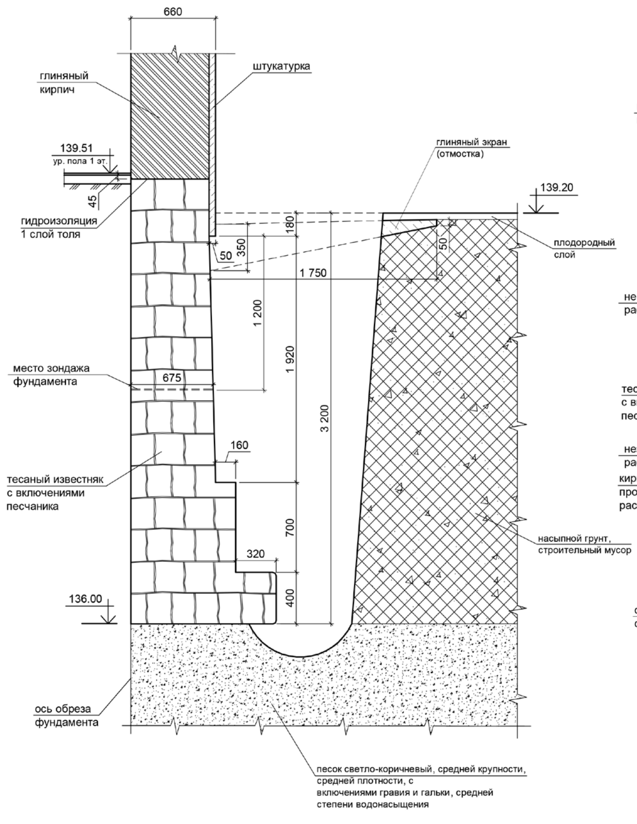
Pit 3. Lower footing



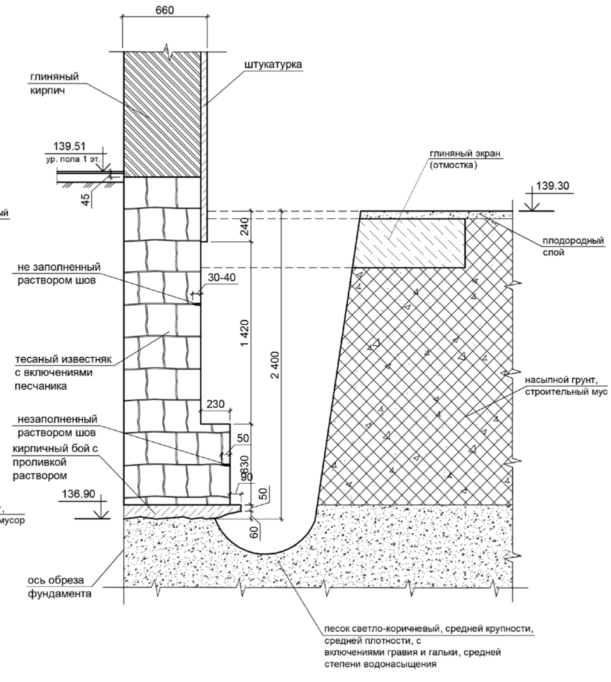
Scheme of pits, 2017-2018



Pit 1. Section



Pit 2. Section



Pit 3. Section

m to 2.44 m from the ground level for the external pits examined in 2006. According to the 2006 data for the internal pits, the depth of foundation ranges from 0.2 m to 0.6 m from the basement floor level.

The depth of the foundations of the building during the construction was taken «on site» and differs depending on the thickness of the filled-up soil. Experts came to the same conclusion in the course of the dynamic probing test (see below). The exceptions are the foundation under the large window of the south façade, which is based on filled-up soil, and the foundations of the basement walls that remained from a former building, which also have a thin layer of fill under the footing. The footing of the internal walls foundations is at a depth of 0.35-0.45 m from the floor level of the ground floor.

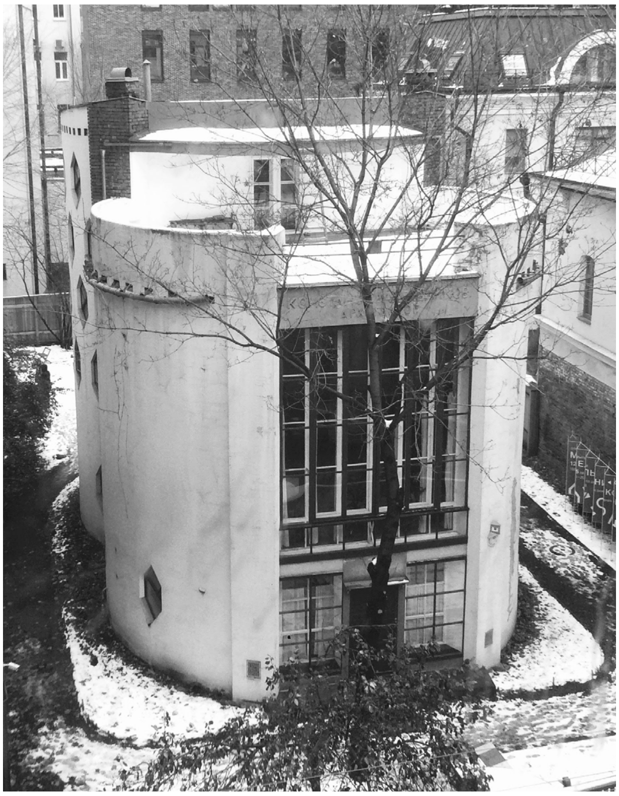
The basement floors are an asphalt screed about 30 mm thick on a layer of crushed brick and limestone. A storage hole (potato pit) is constructed similarly, but a cement sand screed is used.

Horizontal waterproofing of the walls is located just above the ground level. For waterproofing tar paper is used, it's applied over the mortar layer, leveling the upper edge of the foundation. There is no vertical waterproofing.

The grading of the area around the building is satisfactory. Along the perimeter of the building a clay screen 1.75-2.04 m wide is made under a layer of soil – it can be considered a clay blind area. The function of water discharge from the walls of the building is also performed by gutters. All over the perimeter of the building the lawn is laid out on top of the soil layer, and along the south façade flower beds are planted.

Bearing pressure, that the footing exerts on the soil, obtained by means of calculation of the building computer model (the sum of the dead load and the snow load 1,5 – 1,8 kg/cm²), does not exceed the calculated soil resistance 2.25 – 5.69 kg/cm².

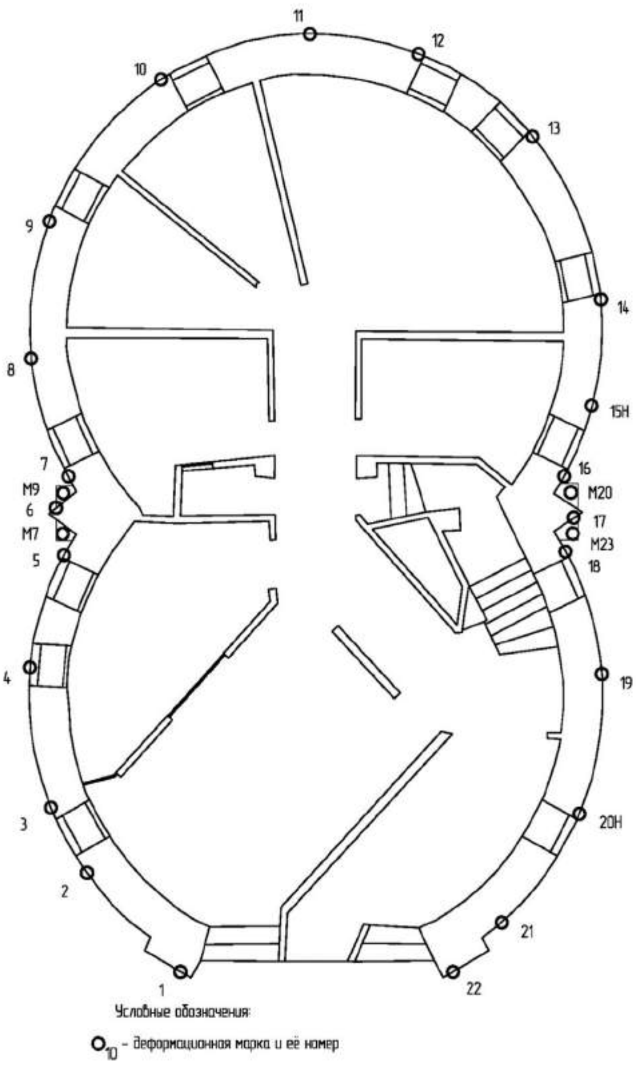
The calculation of the deformations showed that the footing is wide enough for the applied and anticipated loads, considering actual characteristics



The Melnikov House. Street facade, view from the southwest

of the soils underneath the footing. The maximum stress in the rubble masonry of the foundations of the building (2.79 kg/cm²), obtained as a result of the calculation, does not exceed the average calculated resistance of the rubble masonry to compression ((5.5 – 6.0 kg/cm²). This means that the bearing capacity of the foundations of the building is provided.

Geodetic monitoring (December 2017 – June 2018) showed the absence of settlements of the building at present. 22 metal survey markers in the walls all over the building perimeter (installed in the 2000s) were monitored. They are quite suitable for further observations. The results were compared with the latest data from January 2013. First five rounds of high-precision geodetic measurements showed settlement for most markers from 1 to 2 mm for a period of five years. The maximum settlement is -1.0mm and +2.0mm. These values are close to measurement errors, that means there are no significant settlements. Small height fluctuations are caused by seasonal changes in the properties of soils under the building foundation, which in turn is caused by temperature differences, water content, snow load and measurement accuracy. The building settlements are within the allowable values for this type of buildings (up to 10 mm).



Scheme of survey markers

The main reason of the former settlements of the exterior walls in the 1990s – 2000s was the impact of construction on the lands adjacent to the House, as well as the long absence of reliable drainage system in the building after the restoration in the 1990s.

The settlements of the building trigger the appearance and opening of cracks that occur in walls. However, it would be incorrect to massively attribute existing cracks to settlement ones as real settlement cracks are few in number and they can only be ascertained after removing plaster layers.

Settlements of the ground floor partitions are caused by the fact that their reinforced concrete foundations, made in the 1990s, rely on filled-up soils. Moreover, compaction of the sand cushion under the foundations is insufficient and loads on the partitions, transferred from the floors above the ground floor, are uneven.

Problems and defects of the foundations:

1) It is significant to mention the presence of filled-up soils (which include organic waste) both under the internal walls of the basement, which have settlement cracks, and under the foundation of the south façade in view of its shallow depth (1.44 m from the surface).

2) The very foundations (constructed in 1927) have some minor defects, mainly as a result of washed-out mortar joints (two places in the northwest pit to a depth of 110 – 120 mm, the rest – to a shallower depth). According to the results of 2006, the foundation of the south wall also has defects in the form of a weak mortar of the foundation masonry (up to its absence).

3) The foundations of the ground floor partitions were constructed in 1996, based on real possibilities "on site", therefore their actual height and width, as well as location under the partitions differ from the project.

4) The exterior wall finish, that is underground and directly above the blind area, is damp, has traces of repairs with cement mortar; there is the 'void' sound in many places when tapping, which means debonding of the wall finish.

5) It is important to note that the filled-up soils outside the building above the footing of the foundations are mostly friable with layers of medium density, having an average water saturation (the same is under the protective clay blind area around the perimeter of the building). The presence of the wide (up to 2 m) waterproof clay blind area creates conditions for soil moistening near the foundations, which may be the cause of increased humidity and the appearance of salts on the surface of the basement walls, which in turn induce weathering of the rubble masonry.

6) Seasonal movements and deformations of the step of the main entrance, which is not structurally related to the building, are also noteworthy.

Geotechnical survey

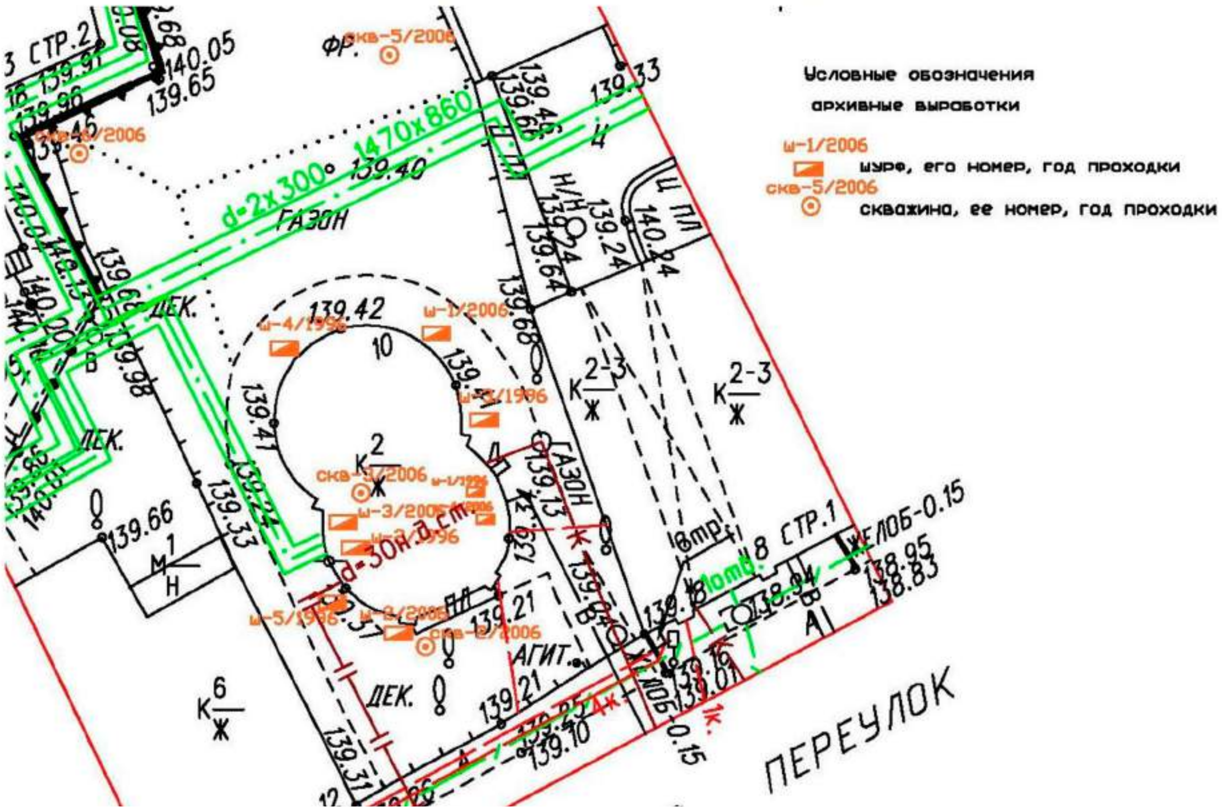
The purpose of geotechnical survey is to clarify the data on the following issues:

- depth of bedrock;
- the presence or absence of loose sands;
- whether there is a karst-suffusion danger of the site;
- presence of a perched water table

In December 2017 – February 2018, the following field works were carried out: drilling of 2 wells 44 m each, digging of 3 pits right outside the walls of the building, geophysical measurements to determine stray currents (120 measurements to determine their existence, 6 measurements of soil resistivity), 3 points of electro-static probing, 3 points of dynamic probing test (DPT) to a depth of 6 m, 6 plate load tests, installation of a piezometer to monitor the level of underground waters, aquifer testing (2 pumping tests in 2 wells); soil sampling for laboratory analysis (105 samples) and groundwater (5 samples).

Well 1 in process of drilling. North-east from the House, 2018

West facade. Foundations at the central heating entry point (former coal storage). 2017



Scheme of archival pits and wells, 1996 and 2006

Scheme of pits and wells, 2017-2018

In the course of geological survey actual check of the foundations of the House was made and samples of rubble stones, limestone and mortar were collected for laboratory analysis. They were used at a later stage of the survey by structural engineers.

Laboratory analysis of the field results and collected samples was performed in February – March 2018 with final report issued in April 2018 in six volumes: geological conditions, dynamic probing,hydrogeology and geological risks, geophysics, geodetic monitoring and summary.

Field results and laboratory analysis showed generally satisfactory conditions of the grounds around and under the building with no long-term risks related to karst cavities and changed hydrogeology.

According to the survey results, the geological conditions of the Melnikov House site are the following:

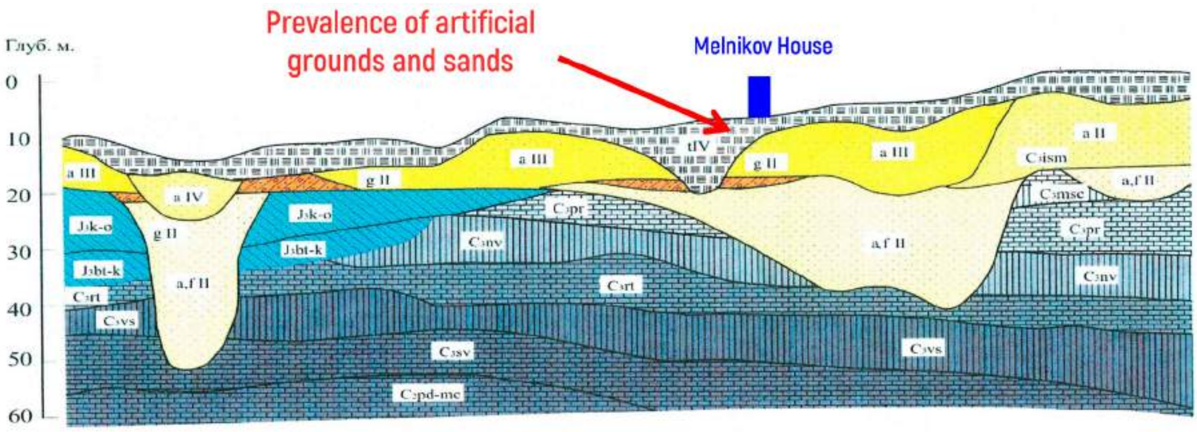
1) from the geomorphological point of view, the site is located within the second (Mnevnikovskaya) alluvial terrace above the floodplain of the Moskva River.

2) geological and lithological structure of the site:

2.1) Filled-up (artificial) soils lie on the ground level and are represented by compressed and damp sands (1.8 – 3.7 m thick) with the inclusion of fragments of foundations, rubble and household waste.

2.2) Upper Quaternary alluvial deposits are represented by medium density and dense, moist and saturated sands (to a depth of 8 – 8.2 m) of various size, with inclusions of gravel and pebble. The presence of loose sands over the surface of

Geological map of Moscow



Geological section of Moscow

moraine layer of clay loams should be noted. Their formation is associated with seasonal fluctuations in the groundwater levels. 1.a.c) Moraine deposits have an eroded undulating roof and lie on the roof of a thick irregular layer of submorainic fluvioglacial deposits. Moraine deposits (up to 5.9 m thick) are represented by sands with separate clay, loam and sandy loam lenses, with the inclusion of crushed stone and gravel.

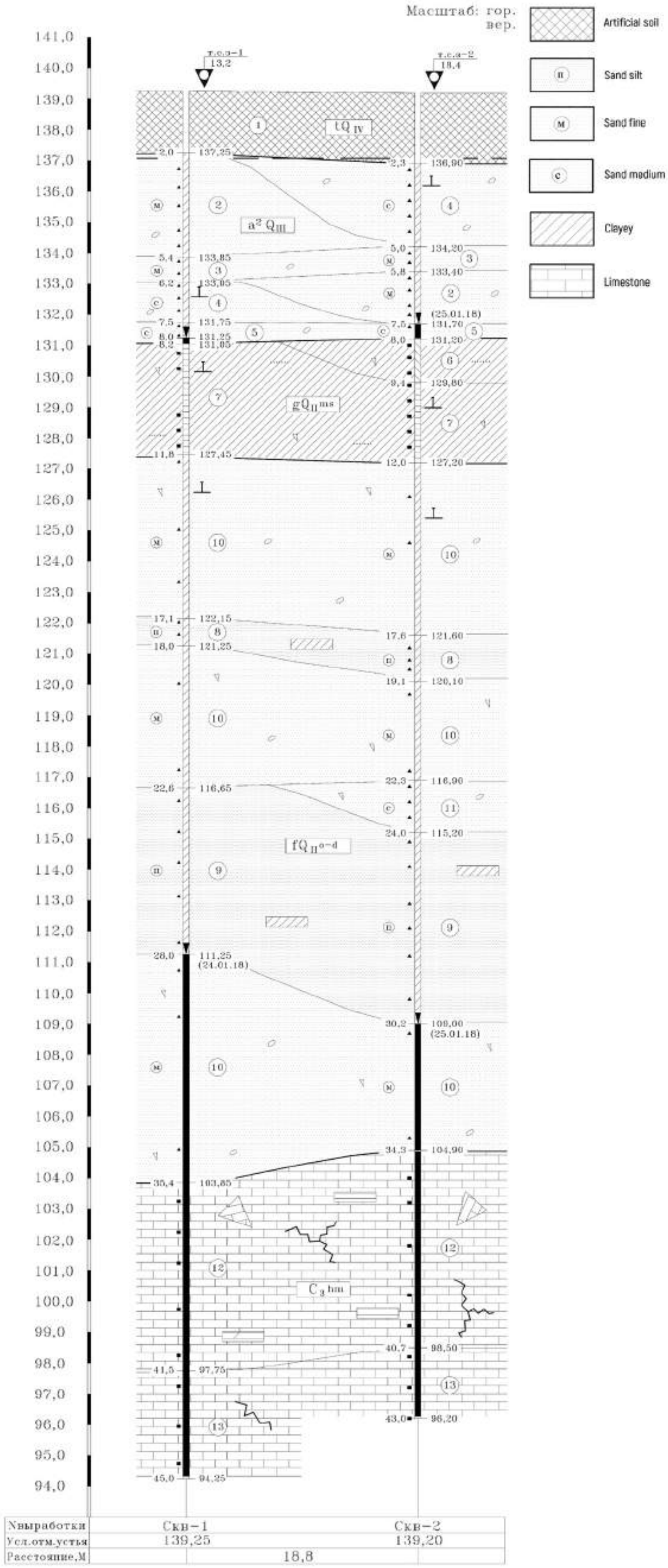
2.3) Fluvioglacial deposits (to a depth of 34.3 – 35.4 m) are mainly represented by sandy silt and fine, dense, less often of medium density, clayey, damp and saturated sand.

2.4) Bedrock is represented by limestones (at a depth of 34.3 – 35.4 m and below) of the Upper Carboniferous. The limestones are highly fractured in the upper part, with sand filled cracks, with frequent interbeds of marls and hard clays. Fractured limestones without inclusions lie under them.

3) Despite the fact that during the survey no karst phenomena was found, the Melnikov House site, as well as the entire territory of this district of Moscow, continues to be regarded as potentially dangerous in terms of karst-suffusion processes.

4) Geophysical survey: there are no stray currents that cause metallic corrosion at the site.

5) Hydrogeological survey: there is no risk of flooding. Hydrogeological conditions of the site, which affect underflooding are: there is a relatively deep groundwater table; water-bearing soils are alluvial sands; confining unit (aquitard) is moraine layer of clay loams. It is supplied by precipitation, as well as by water leakage from the underground utilities. The groundwater table lies at depths of 7.5 – 8.2 m, it is of small thickness and depends on seasonal climate variations. Its level was observed at a depth of 5.9 – 6.5 m in 1996, 6.9 – 7.3 m in 2006, 7.0 – 8.2 m in 2007, 6.9. – 7.3 m in 2013 according to the archival data. Hydrodynamic regime of the groundwater table is formed due to large-scale long-term artificial drainage. The drainage of the territory is carried



Geological section, 2018

out in order to ensure the safe operation of nearby objects, including the Moscow Metro. There is also unconfined aquifer of fluvioglacial and the Upper Carboniferous deposits in both wells at depths of 28.0 – 30.2 m. It is fed by lateral inflow. Water-bearing rocks are fluvioglacial sands deposits of the Quaternary period and fractured limestones of the Upper Carboniferous. Special hydrogeological conditions of the territory should be stated: according to the archival materials, since the beginning of the 1930s. there had been a gradual decrease of quantity of groundwater in the aquifer, caused by artificial factors. Subsequently the quantity of groundwater in the aquifer has been increasing again and decreasing due to possible cessation and resumption of the action of artificial factors (pumping, etc.). In case of termination of the artificial factors, the aquifer may recharge to its natural level, i.e. to a depth of 16.0 – 17.0 m from the ground, which will not affect the building.

6) The results of dynamic probing reveal that the lower level of the filled-up soil coincides with the level of the footing (or higher). Melnikov's decision relative to the different depths of the foundation walls was not accidental. It was made because of different soil density under the footing. Dense sands and sands of medium density are lying under the footing in the south and southwest parts of the building (where the minimum foundation depth is 1.9 m). Because of the absence of this layer and it's replacing with loose sands and filled-up soils, Melnikov had to increase the depth of the foundations significantly (to 3.5 m) in other parts of the building.

7) Filled-up soils are represented by loose sandy soil (which is the most loose near the north downspout) with rare layers of medium density. They also include brick and limestone fragments, as well as household waste, which is typical for the occupation layer. Filled-up soils have an average degree of water saturation.

8) According to the results of the DPT to a depth of 6 m at three points along the perimeter of the building (north, southeast and southwest), it was found that sands of medium size, medium density, low moist lie under the foundations, and in the area of the northern downspout – coarse loose sand.

9) It is noted that in the soil mass, under the base of the building, there is a decrease in density of sands with an increase in depth down to the moraine loams, which are the confining unit (aquitard). At a depth of 5 – 6 m from the ground, ancient alluvial sands are loose almost everywhere.

10) Nevertheless, no decrease in their density, compared with 2006 data, was registered. For more than 30 years of observations the geological structure and physico-mechanical properties of soils to a depth of 45.0 m have not undergo significant changes either. Although attention should be paid to loose soils in the upper part, probably owing to anthropogenic (including application of technology) factors.

11) In the course of both surveys (2006 and 2018), artificial soils were also found under the foundations of the basement internal walls – of medium density with crushed brick and limestone, which can be fully considered as preparation for the foundations. They appeared much earlier, during the construction of the walls of the 19th century building, which preceded the Melnikov House.

12) The foundation under the south (glass-fronted) façade also rests on filled-up soils to a depth of 1.35 m. They are loose and weak, contain many organic elements, such as roots of shrub and trees. Despite the fact that the south façade of the building is lightened in weight, these soils require special attention.

Recommendations on the results of geotechnical survey are:

1) to minimize excavation work (wells, pits, etc.) near the building to prevent artificial weakening of the soil under the footing,

2) to continue geodetic monitoring of the settlements of the building,

3) to continue hydrogeological monitoring the water table,

4) to pay special attention to loose and weak soils along the south façade using the building.

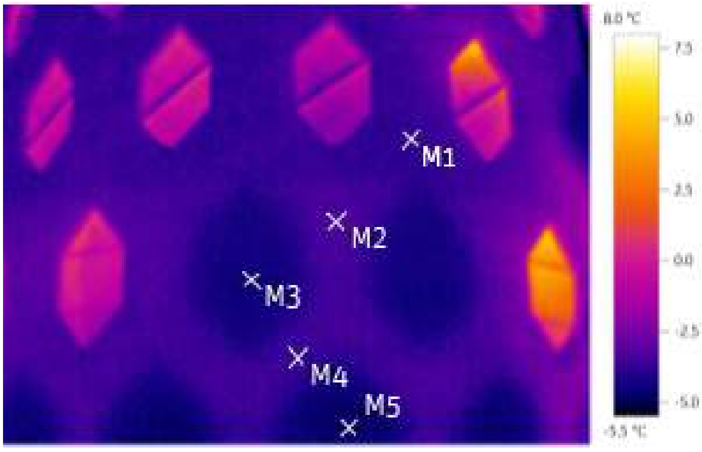
Survey of structures in detail: openings and infrared thermography

Walls, partitions and pillars

The walls of both cylinders are made of bricks (solid brickwork 0.64–0.69 m. thick, taking into account the finishing layers), they bear the load from the intermediate floors and the roof and transfer it to the strip foundations. At the junction of two cylinders the walls are united by brick chimneys. The upper part of the walls of the small cylinder (terrace parapet) is made in a half brick thick. The walls are made of solid clay brick on a complex mortar "in racked joint" type of brickwork. The bond type is the following: one stretching course per heading course. It was designed by K. Melnikov: every two wythes have a 1/4 brick shift from the surface of the wall (in the radial direction) and each course has a 1/4 brick shift within the plane of the wall (in the annular direction). At the same time, the walls have a regular checkerboard pattern of hexagonal apertures. They are used for 63 windows, and the other 56 apertures are closed up (mainly with masonry 1/2 brick thick, although the apertures on the three upper levels of the small cylinder are closed from the outside with wooden shields) and filled up with a loose mixture of sand, clay fragments and construction debris.

Both cylinders are cut along a chord from the south. There is a wooden roof truss in the large cylinder (in the level above the roof of the small cylinder), plastered on both sides. The south façade of the small cylinder includes windows with the entrance door on the ground floor and a large window on the first floor. The window frames are wooden.

In addition to the vertical load, there is also lateral pressure of soil, exerted on the basement walls. The exterior walls of the same annular form in plan are a rubble masonry set in a complex mortar. The interior brick walls of the basement remained from the previous building and were incorporated into the house structure during its construction in 1927 – 1929. The brick walls bear the loads from the intermediate floor of the basement, brick pillars of the ground floor and the structures of the stairs to the basement.

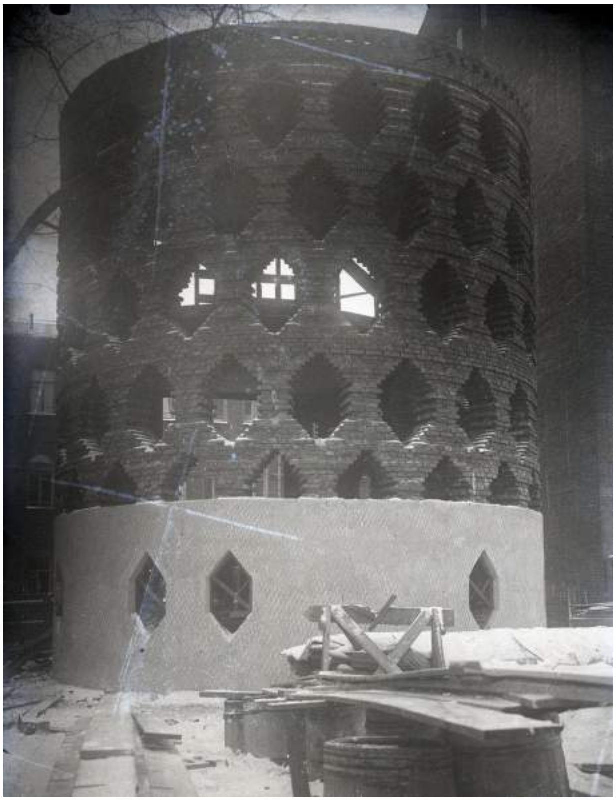


t °C	
M1	-4.0
M2	-3.3
M3	-4.5
M4	-4.0
M5	-5.0

Thermal image. Fragment of the northwest façade

The cellular structure of the walls is clearly visible. The thermal protection of the filled up openings is shown. There is a fairly clear border on the intermediate floor between the first and the second levels – the bedroom is heated better. The temperature is much higher near the heating air duct (the rightmost windows).

In general, the condition of the walls is operational with an unsatisfactory state of the finish. The bearing capacity of the walls is sufficient for taking existing and planned loads. The maximum stress in the most loaded level of the lower row of brick walls in between the windows does not exceed 60.83 tf/m², with the maximum allowable stress of 153 tf/m².



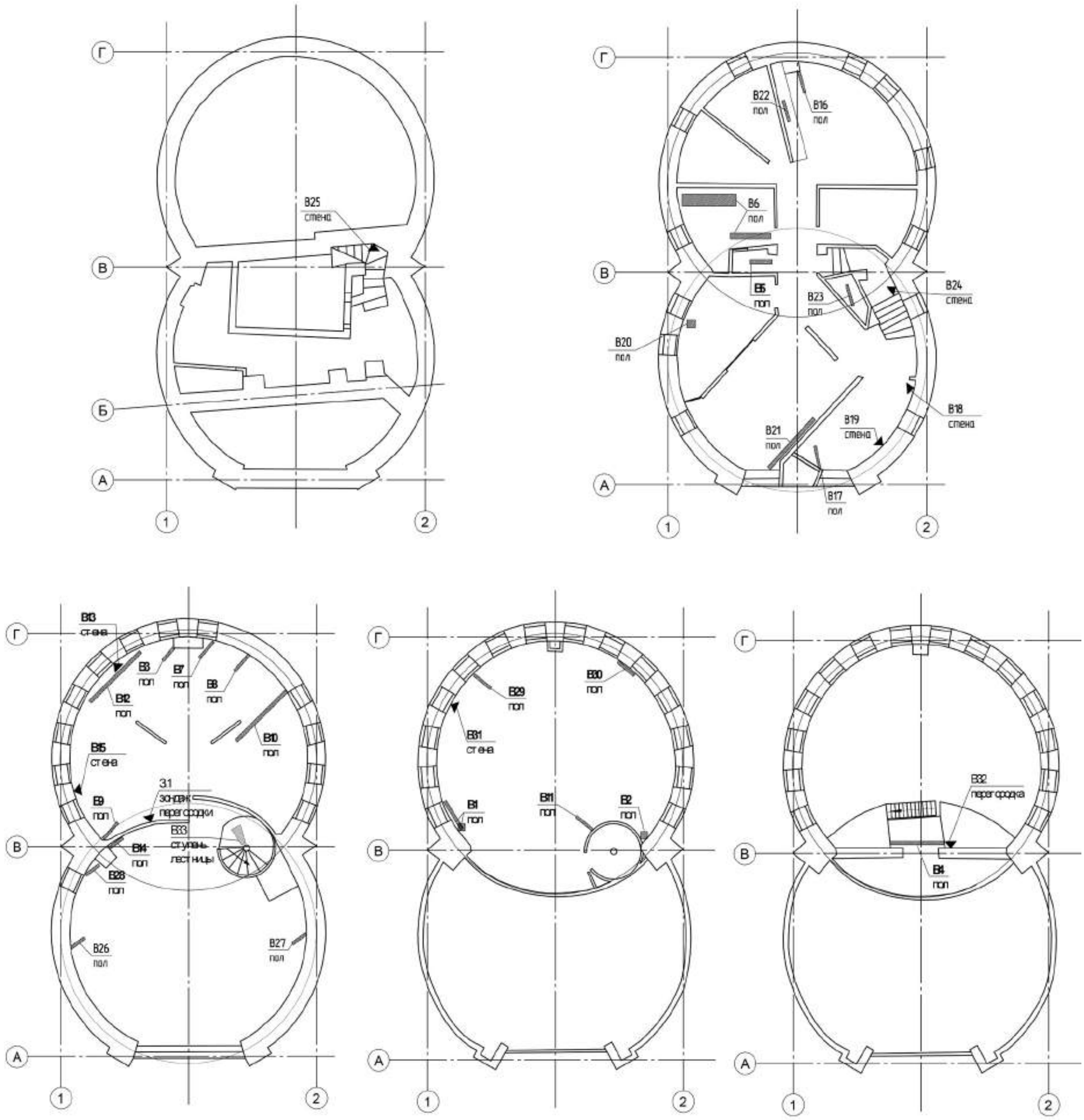
View of the large cylinder from the northeast. 1928

The dangerous condition of the finish under the eaves near the downspout of the north façade and the parapet is significant.

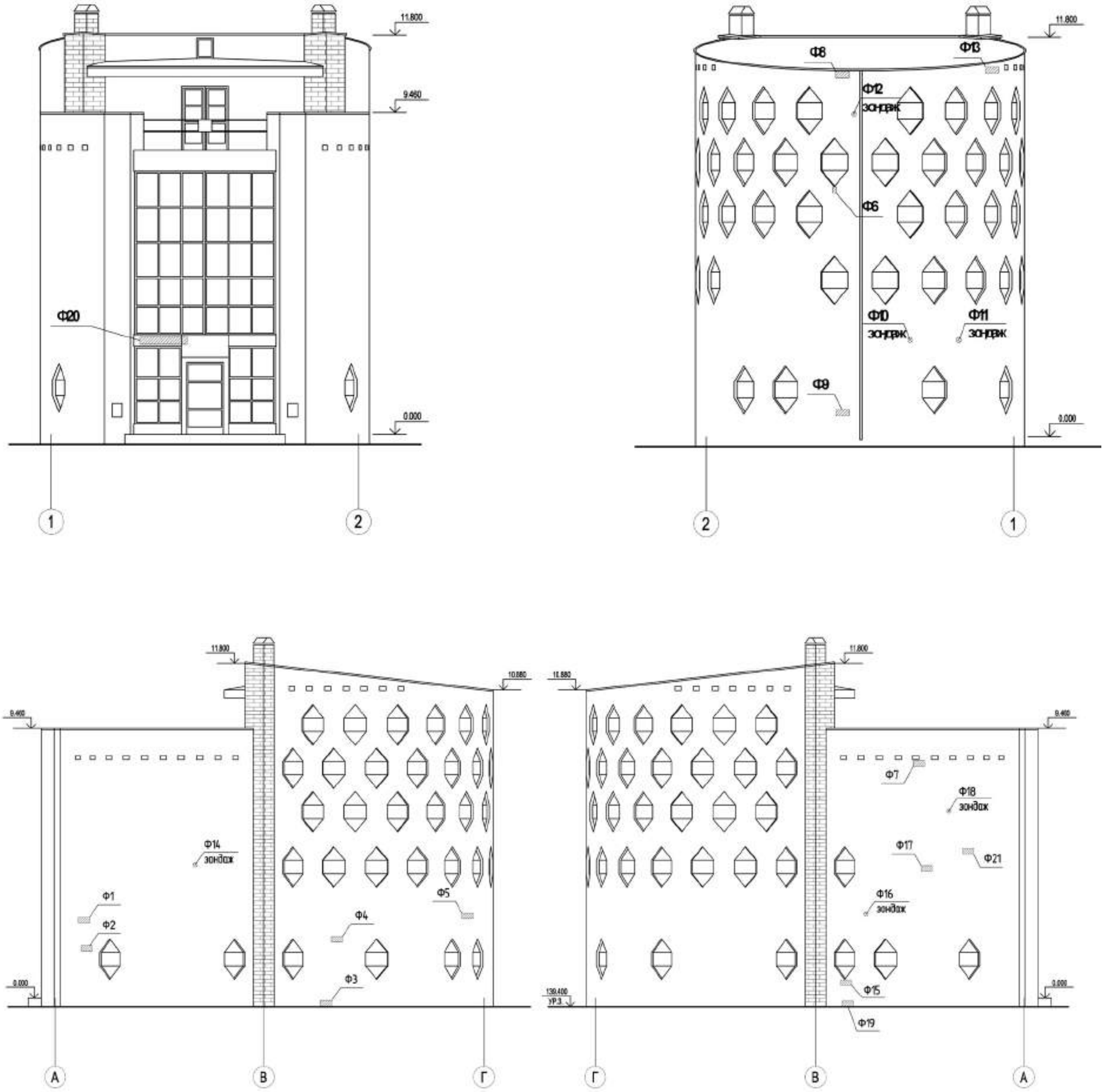
There are also cracks in the finish of the walls inside the building (along the borders of the filled hexagonal apertures and run of utility networks, which (with the exception of several places) do not reach the masonry of the walls. There is mechanical damage and dirt on the finishing layers of the walls. The brick walls of the basement have defects such as cracks up to 3 mm wide, however, the installed survey markers show that the deformations have stabilized. The defects of the rubble masonry (which does not have a protective plaster layer) of the basement external walls should also be mentioned: efflorescence, crumbling of loosened mortar and stone, and rising of dampness in walls when the heating systems are off.

Living room on the first floor, view to the staircase. Loss of plaster on the staircase enclosure.

Living room on the first floor. The crack at the junction of the wooden joist and the brick wall. Cracks in the ceiling under the projection of the large cylinder



Scheme of the openings inside the house



Scheme of the façades openings

Pillars

Near the intersection of the cylinders (at the level of the ground floor) there are two brick pillars, which bear the load from the intermediate floor of the ground level and transfer it to the inner brick wall of the previous building. The pillars are plastered and combined with adjoining partitions by the finish.

In addition to the brick pillars, there is a wooden pillar in the building. It is made of a log, covered with tinplate (at the level of the basement – with bricks), which goes from the basement to the lower part of the small cylinder roof floor. The wooden pillar is the central support of the spiral staircase.

The condition of the building pillars is operational. The bearing capacity of the pillars is sufficient to take existing and planned loads.

Partitions

All the partitions of the building are involved (more or less) in taking loads from intermediate and roof floors. In the 1990s, the conservators, knowing this fact, tried to increase the stiffness of these support structures by arranging monolithic reinforced concrete strips under them on filled-up soil.

The partitions are solid, wooden, made of vertically installed boards 50 – 60 mm thick (in some places reinforced with horizontally or diagonally fastened boards) plastered on both sides.

The partition between the large cylinder and the terrace is a roof truss one. It is a truss with diagonal braces (struts) and wooden posts, sheathed on both sides with a tongue and groove boards and plastered over lath. It takes load from the large and small cylinder roofs and distributes it through the walls between them and the spiral staircase pillar.

In the basement there are brick partitions on their own foundations that separate the heating room from the rest of the basement. These partitions can join the work of the basement ceiling.

The condition of the partitions is limitedly operational with the unsatisfactory state of the finish. The bearing capacity of the partitions is sufficient for taking existing loads. According to the results of the calculation, the stress in the most loaded wooden partition (first floor of the large cylinder) is 18.416 kgf/cm² and does not exceed the obtained second quality wood strength properties (100 kgf/cm²) and critical stress too (33.86 kgf/cm²). All this testifies to the fact that both toughness and stability of the most loaded partition of the building is insured with a margin.

There are cracks in the brick partitions of the heating room in the basement. Almost all wooden partitions of the building have cracks in the plaster layers where they meet more rigid structures (brick pillars, walls, intermediate floors). The partitions of the ground floor in the large cylinder have obvious settlement cracks. New foundations, laid under partitions in the 1990s and set on filled-up soils, settled irregularly. Uneven loads from the partitions caused inevitable settlements because of compaction of soils.

The following photos of selective openings show condition and structure of the walls:

Opening B13

Location: the lower part of the northwest wall in the bedroom on the first floor in the large cylinder. Plaster layer is opened up to the brick masonry. The following samples were taken: light-yellow paint of the walls, plaster, masonry mortar of a bricked-up hexagonal aperture and its filling of sandy-clay mixture.

In the photo: a filling brick of the hexagonal aperture differs in color and size (some bricks were used for the second time, because they used to be a part of the previous building). The filling is not fastened to the main wall masonry. When attempting to drill the filling, the brick starts to move. Mortar of the filling is much weaker than the one of walls masonry.

Opening B19

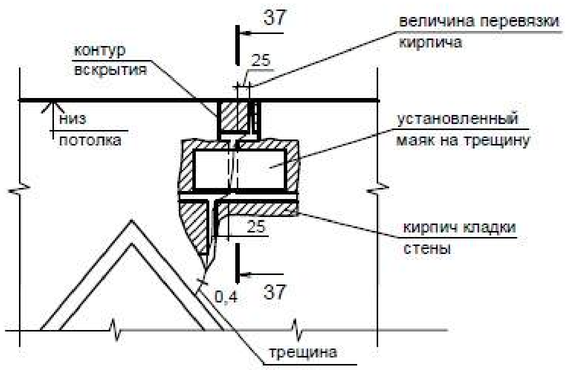
Location: semicircular lobby on the ground floor in the small cylinder on the east wall at the junction of the wall masonry to the bricking-up of the hexagonal aperture. Plaster layer is opened up to the brick masonry. The following samples were taken: plaster layer with paint, filling of the hexagonal aperture and masonry mortar.

In the photo: on the left – masonry of the wall, on the right – the bricking-up, which was made without brick shifting typical of the main brickwork.

Opening B31

Location: under the ceiling in the studio on the second floor in the large cylinder to the left of the metal air-conditioning duct. Plaster layer of the wall was opened. The composition of the finish and the surface of the brick masonry were analyzed at the crack. A sample of the plaster with paint was taken.

In the photo: a through-wall crack passes along the head joint between bricks. There is no crack on the gypsum survey marker of the 2000s. The gap between the sheathing of the attic floor and the wall is seen above.



Opening B31. Wall of the studio. 2nd floor

Façades

The exterior walls have significant physical deterioration – they are covered with a net of settlement cracks, increased under climate impact, and the lower part of the finish has traces of repairs with cement mortar, in some places it detached from the brick masonry and has "void" sound when tapping. The network of cracks along the wall sections with different thermal conductivity, cracks owing to particular causes (adjoining of tree branches and physical impacts) and the presence of repaired places should also be noted. The walls under the metal windowsills are more damaged by water stains and cracks; there are also traces of repairs with cement mortar there. Near the drip caps (mainly near the downspout of the north façade) there are cracks and plaster layer detachment because of regular moistening of the masonry due to the roof leaks. It even comes to a dangerous defrosting of the wall masonry near the edge of the roof. The same type of defects include detachment of the plaster layers and defrosting of the upper masonry courses of the terrace brick parapet. The paint layer there is in complete disrepair.

There are cracks up to 1 mm thick in the brick masonry of the walls (including at least one through-wall crack). These cracks are difficult to attribute to settlement ones – each should be opened up to the brick masonry and analyzed separately. The most pronounced crack above the upper window in the west façade of the large cylinder is a consequence of insufficient joint bonding, pressure of the roof north support beam and, possibly, the effect of settlement deformations.

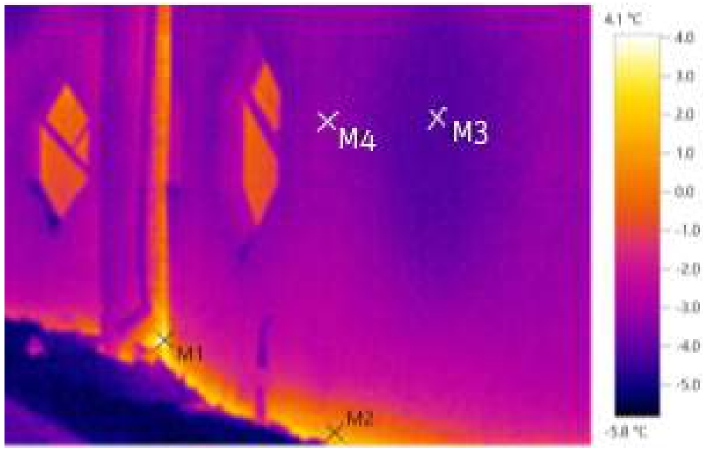
The opening revealed that the outer filling – the wooden shields of the filled-up apertures are damaged by rot, bast fiber fabric over the wooden boards degraded and the adhesion of the plaster layer to the wooden boards was lost. During the opening of the bricked-up apertures of the exterior walls (from outside and inside), it was found that the bricks move even because of a slight impact on them. This confirms the assumption that the bricking-up mortar is significantly weaker than the wall masonry mortar.

Lintels

The function of lintels above the ground and the first floors of the south façade is performed by tram steel rails (type "Phoenix") of profile № 2. The rails are laid between the west and east walls of the small cylinder. The filling above the doors of the main entrance is made of wooden framework, and above the large window there is a façade inscription 'KONSTANTIN MELNIKOV ARCHITECT' made of a reinforced layer of mortar on a wooden base, fixed on the protruding wooden intermediate floor of the small cylinder and the walls of the terrace enclosure.

Windows in the brick walls of the building due to the special design of the masonry are made without lintels.

The condition of the metal lintels is operational. The wooden elements of the filling suffer from movements of the supporting structures, temperature and humidity fluctuations, because of which cracks appear.



t °C	
M1	4.1
M2	1.2
M3	-4.5
M4	-3.3

Thermal image. Fragment of the southwest façade

Heat loss at the bottom of the wall and along the brick chimney. Snow melts near the wall because of temperatures above 0°C.

Windows and doors

Windows due to the features of the brick masonry of the walls have the same hexagonal shape, with the exception of the large window and two windows at the entrance of the south façade. There are two hexagonal wooden frames in every single hexagonal aperture, with the exception of the one on the west façade of the small cylinder in the hall, which is octagonal. Windowsills are made of galvanized painted metal.

The window structures of the south façade are rectangular and fill the south façade almost entirely. Window openings with two wooden frames are symmetrically located on the ground floor, on both sides of the front door. Above them, at the intermediate level of the ground floor, frames with wooden filling are arranged, and at the level of the first floor there is a large window (4x5 m) with two wooden frames and double-opening panes. The interior frame of the large window stands on the floor of the living room, and the exterior one transfers load to the underlying structures – mainly to the doorway jambs. The window frames of the ground floor and the large window of the south façade, as well as the octagonal window of the living room were restored in the 1990s.

The doors in the building are wooden paneled. The exterior door with wooden filling was restored in the 1990s. The interior doors are panel glazed ones (including a door to the terrace).

The condition of the window and door fillings is generally satisfactory, with the exception of the large window, the lower part of which was damaged by rot so, that it can be attributed to dangerous structures. The following defects should be noted: the loss of paint layers, slight loosening of the wood surface and minor rot damage to the window frames (most pronounced in the upper openings of the large cylinder). Glazing of windows and of the large one has damage in the form of cracks and scratches in places, some frames of hexagonal windows have increased gaps between the frames and removable window panes. There is a problem of condensation between the frames. The large window of the south façade has significant defects – the lower support beam is damaged by rot to the full depth, and the wooden plank filling under it is damaged by surface rot. Vertical rods of the lower frame of the large window deformed a rotten horizontal beam (crushed it). The large window has a common deformation in the form of buckling out of its central part. The load from the large window, applied to the doorway jambs of the main entrance, deformed them – they are also out of the plane.

Opening F8

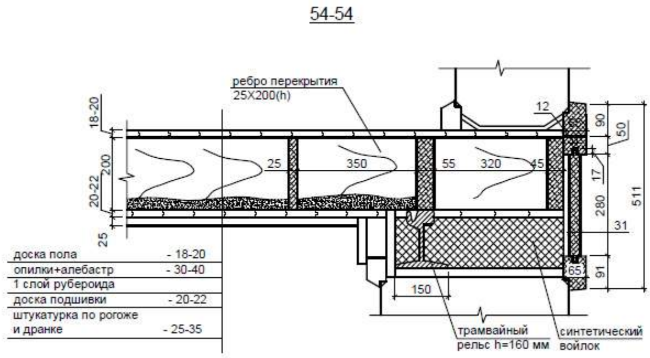
Location: the north façade of the large cylinder under the roof of the building. The plaster layer of the wall was opened. Brick masonry (damaged by defrosting) was found. The following samples of materials were taken:

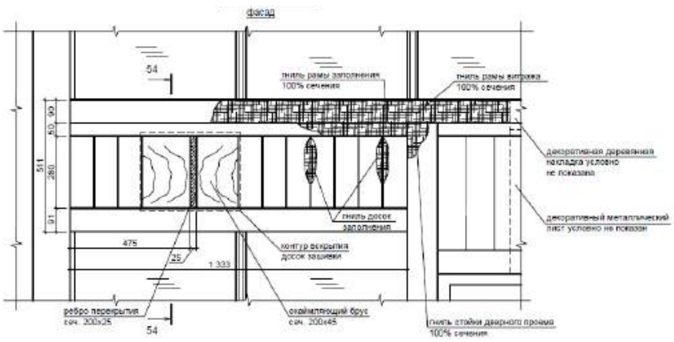
- light gray plaster;
- gray plaster;
- red-orange brick;
- layers of white paint.

In the photo: plaster, damaged by cracks and plaster debonding. Damage to masonry by defrosting, there is the "void" sound and movement of bricks when tapping. At the time of opening he masonry was moistened due to the roof leaks near the downspout.

Opening F20

Location: the south façade of the small cylinder, at the bottom of the large window. Steel panels under the large window were opened, wooden planks of sheathing were removed. The structure of the intermediate floor corbels under the window and the state of the wooden structures were studied. Paint samples from the wooden sheathing, as well as mycological samples from the frame wood and the wood filling under the large window were taken.





Opening of the metal sheathing. Visible old paint and wooden planks, filling the frame.

Rot on the lower frame of the large window (in some places it can be pierced with an awl), on the frame under the large window. Surface rot on the wooden filling of the frame under the large window.

Filling under the large window. Below is a bar, to which the lining of the window of the ground floor is attached. There is a layer of roofing felt on top of the bar and further, between a rail and the joists of the intermediate floor. The bottom sheathing of the intermediate floor is made with a gap (due to the insertion of bars) with ribs and the front board, installed between the ribs. Thermal insulation with padding polyester was made in the 1990s. There are traces of moisture on the front board.

Opening of the frame filling under the large window. A visible end of a joist of the ground floor grid. Traces of the front board wetting. Traces of moistening of the filling planks and their surface rot.

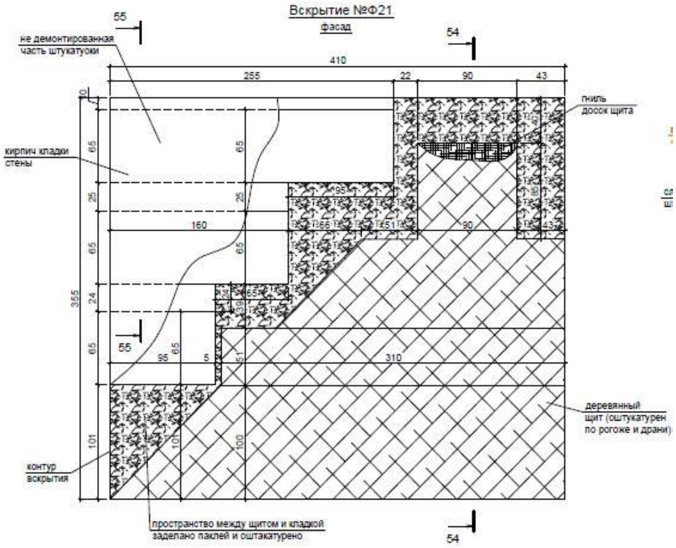
Opening F21

Location: the west façade of the small cylinder, the first floor at a height of the fourth row of hexagonal apertures. Opened plaster layer of the wall at the top of the aperture. A wooden shield, inserted into the aperture and a filling-up behind it, were found. The shield is installed flush with the internal level of the masonry (the masonry protrusions extend beyond the shield), and accordingly has a significant plaster layer.

During the opening, straw and dry grass were taken out of the gaps between the wooden shield and the brickwork. The filling-up was also removed to the entire depth of the aperture up to the interior brick wall of the living room.

The composition of the filling-up is close to the one of filled-up soils, found during excavation of the pits and foundations of the partitions. Thus, presumably, that is the same soil, excavated during making the trenches for the building foundations.

After the examination, the filling-up was packed back into the aperture. The gaps between the shield and the brick walls were firmed with tow fiber, the lath was restored and the aperture was plastered anew with the repair compound.



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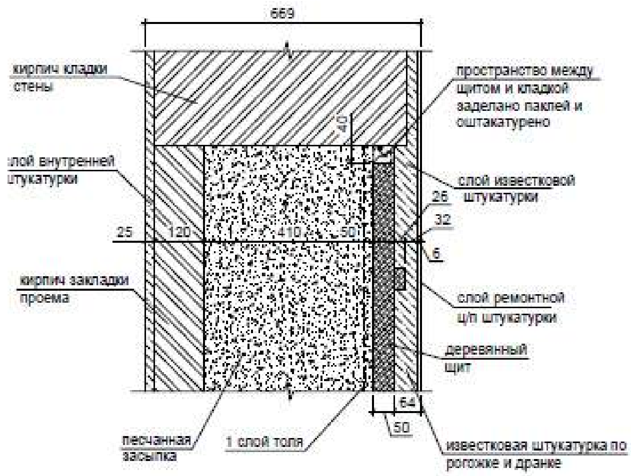


Rot on the edges of the wooden shield. Horizontal bar is loose as its connections lost strength. The tar paper layer lost its flexibility and became fragile. The layer of bast fiber fabric decayed (its remnants are visible on the right), therefore the adhesion of the plaster layer with the shield is lost.

In the background is a brickwork of the aperture from the side of the living room. A heterogeneous composition of the filling-up is also visible. The shield wood is affected by rot. Tar paper does not cover the perimeter tight, there are chinks along the filling-up contour.

Intermediate floors

Basement, general view from east to west. Cable hooks made from reinforcing bars are visible under the ceiling. There are cracks in the floor.

The eastmost beam of the intermediate floor rests on the wall. The beam corrosion, porous surface of concrete and corrosion of reinforcement.

Intermediate floor of the basement and floors of the ground floor

The intermediate floor of the basement is reinforced concrete, made from monolithic sections with a height of 100 – 120 mm each, poured between metal beams (a tram rail "Phoenix" №2), laid with a step of 1.05 – 1.17 m. The intermediate floor takes the load from the floors and partitions of the ground floor and transfers it from the metal beams to the two interior brick walls of the basement, and along the edges – from the reinforced concrete slabs, adjacent to the exterior walls, to the exterior walls of the basement. At maximum loads the brick partitions of the heating room are also involved in the work of the basement intermediate floor.

Coarse aggregate in the concrete consists of crushed brick. Reinforcement is from smooth bars with a diameter of 5 – 6 mm and spacing of 100 – 170 mm. The lower surface of the intermediate floor is the ceiling of the basement.

The floor of the ground level was replaced in the process of restoration of the 1990s (its structure was also changed – its battens were laid on a system of reinforced concrete slabs, under the battens of the floor above the basement waterproofing was laid, under the floor of the bathroom the inclined concrete slab was set up).

The floor over the basement intermediate floor is a layer of construction debris, poured with mortar, and screeded with a sand and cement. On top of the screed, over the damp-proof pads, battens are laid flat, on which in their turn the tongue-and-groove boards of the flooring are laid.

The condition of the floors is generally satisfactory, except for the bathroom floors.

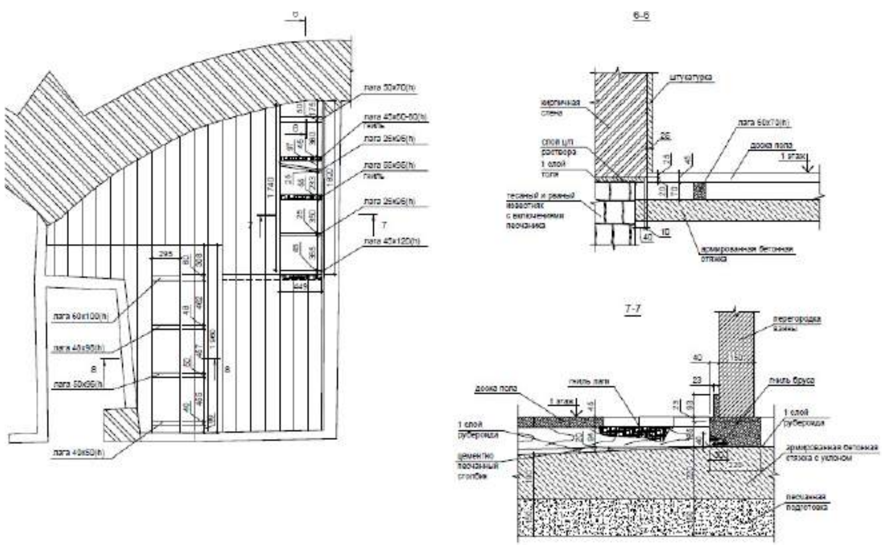
Of the common defects, it is necessary to point out the low quality of the floor material (a thinner board compared to the one of the original floors), their unsteadiness and sags when walking, local damage to the grooves and signs of deterioration (wear out in passing places, loss of paint layer, dirt and minor damage). Ventilation of the floors of the ground level is not provided, ventilation grilles in the floors were

Ground floor. Opening in the toilet with a possible historic wall on the right side. T. Mustonen. 30.03.2018

not found. The drying effect of the heat ducts passing under the floor of the large cylinder. Regarding the bathroom floors, it is noteworthy that after the restoration of the 1990s, rather quickly, the battens and boards of the floor were affected by rot, as a result of water stagnation under the floor. Part of the rotten boards was subsequently replaced, new temporary battens were added. Nowadays, the use of the bath is limited, the accumulation of water is excluded.

Opening B6

Location: the bathroom on the ground floor of the large cylinder.
Opening of two boards of the floor in the bathroom and the reinforced concrete screed under them.
The boards are fastened with nails to battens (the nails are hammered on top, the boards are not grooved). In the opened area, the filling-up, the boards and the battens, the supporting part of the partition, the inclined screed under the floor, the foundation of the partition, the bottom of the brick wall of the large cylinder were examined. Samples of the plaster layer and paint were taken, as well as a mycological sample of the bottom bar of the partition between the bathroom and the children's room.



Opening B6. Bathroom. Ground floor

Place of the opening of the inclined reinforced concrete screed is seen between the battens.

Inclined screed under the bathroom floor. The battens rest on the brick and mortar projections through the waterproofing pads. There are battens affected by rot.

Opening of the inclined screed. The foundation of the partition between the children's room and the bathroom was not found. Visible loss of paint layers at the bottom of the wall.

Opening behind the bath. Visible rotten battens and new battens, temporarily replacing them.

Opening of the inclined screed. The screed adjoins the reinforced concrete foundation of the partition, which partially extends on the brick wall of the basement, and at the same time is based on a sand pad.

Dressing room on the ground level. Cracks in the ceiling, falling of the plaster layer. Parts of the remained plaster hang loose on the lath, bast fiber fabric and burlap, which cover the lower sheathing of the intermediate floor, and gradually crumble.

The intermediate floor of the ground level

The intermediate floor disks of the ground floor of the small and the large cylinder represent a single structure, covering the entire area of the building with the exception of the staircase opening. The intermediate floor tranfers the load onto the external walls of the cylinders, the partitions and the brick pillars of the ground floor, the partition of the staircase and the steel lintel of the south façade window. The intermediate floor disks rest on the interior protrusion of the brick exterior walls, the rim joists run flush with the inside edge of the protrusion, and the edges of the grid extend onto its entire width and in some places are even brought inside the filled hexagonal apertures.

The grid of the intermediate floor represents joists (200x25 mm each) with a 500x500 mm gap between them, notched out at half width and intersecting. The resulting joints are firmed with wooden wedges. The structure includes rim joists, bordering the grid on the supports, and the sheathing on both sides, made of the tongue-and-groove boards, which are laid diagonally at an angle of 45 degrees relatively to the grid; the boards on one side are perpendicular to the boards on the other side. The sheathing forms the ceiling and the floor of the ground and the first floors, respectively.

The filling inside the joist cells are made of a layer of 'milk of lime' with a sawdust filling-up over a layer of tar paper (above the large cylinder mainly without it). At repaired places there is a layer of roofing felt or mineral felt below the cells, and construction debris is found on top of the filling.

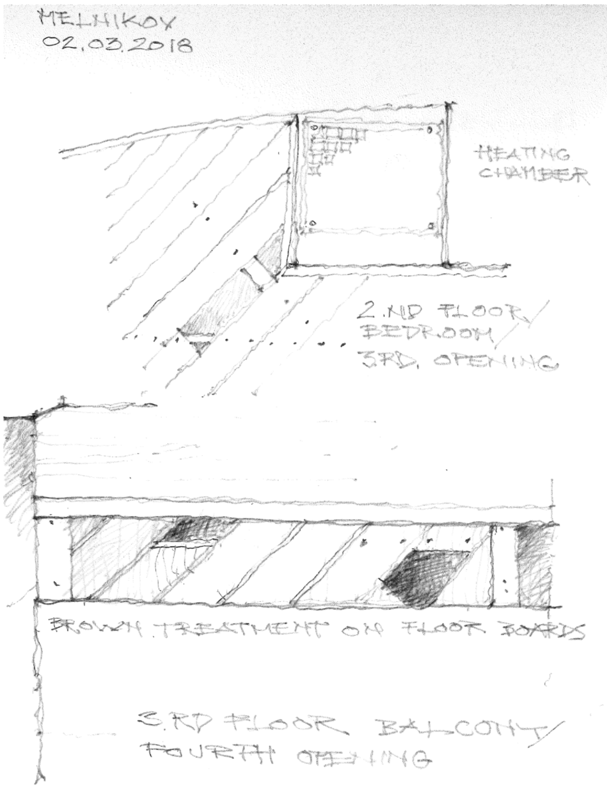
It should be pointed out that the interference into the intermediate floor of the ground level during the restoration of the 1990s was significant. Over the small cylinder, the living room floors were almost 100% replaced, local repairs of the grid in places damaged by the fire and rot were performed, reinforcement of the grid that continues onto the tram rail of the south façade (ends of the grid edges, passing over the rail and damaged by rot, were replaced). The intermediate floor of the large cylinder was jacked up in order to reduce deflection which resulted in deformations, then local repairs of the bedroom floors were carried out. Traces of repairing the bedroom floors were also found (leveling of the upper edge surfaces of the grid with strips) of unclear dating (possibly of the house construction period).

The condition of the intermediate floor of the ground level is limitedly operational. According to the results of verifying calculations, its bearing capacity is sufficient for the existing dead loads and live loads from groups of visitors with a total weight of up to 1000 kg.

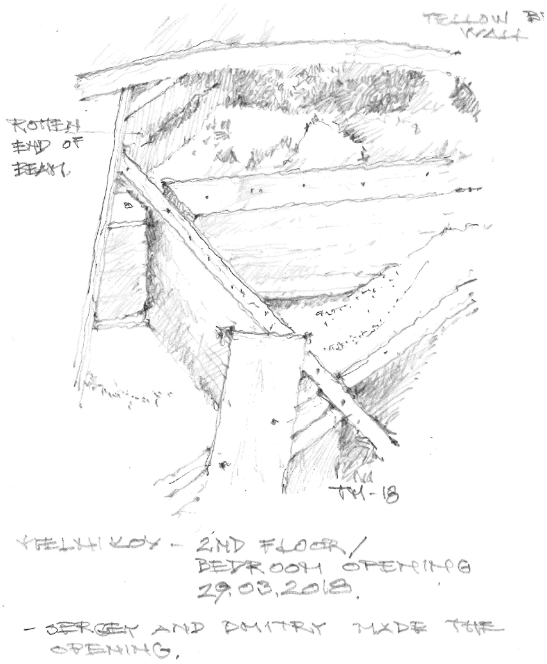
Among the defects, it is important to note significant deflection deformations (the accumulated deflection under the dead load reaches 55 mm in the toilet room) and the deflection increment under live loads. The consequences of the intermediate floor deformations are cracks in the ceiling of the ground floor (including along the perimeter of the ceiling at the junction with the walls) up to the collapse of a significant area of plaster in the dressing room, deflection of the floor of the first level. The defects that create the prerequisites for reducing the rigidity of the intermediate floor include the weakening of the wedges that firm the joist notches, the worsening of the joint work of the joists due to lengthwise cracks in the joists at the level of the cuts, and the presence of irregularities in the joist flat surfaces (defect of construction work) and, consequently, sheathings do not fit tightly to the joists of the grid, which increase loosening of nailing. There are features in the bedroom that probably evolved when the intermediate floor was jacked up in the 1990s – the floors under the partitions have dents in places, and there are more lengthwise cracks in the joists of the grid and which are wider.

Separately the damage by rot of the intermediate floor of the ground level should be mentioned. It is especially evident in the bedroom – there is rot damage to the joist ends of the grid that extend beyond the rim joists (it is more typical of joists built-in the masonry walls). The floor openings in the living room revealed the rot damage to the supporting ends of the joists of the bearing grid of the small cylinder – but the damage is much smaller in size than the one to the intermediate floor of the large cylinder.

The condition of the floors of the first level is unsatisfactory within the bedroom (due to the presence of deviations from the horizontal, deflection of the intermediate floor) and satisfactory within the living room. It is also necessary to point to local damage to the tongue-and-groove joints, their unlocking because of drying and interruption of their united work (the worst condition is in the bedroom), local deflections of the floor boards, dangling sections of the boards not brought to the supports. When walking, the boards move, bend and creak. Traces of mechanical damage accumulated on the floors; there are places locally repaired in the 1990s.



Bedroom floor opening near the north wall and the mezzanine floor opening in the studio. T. Mustonen. 02.03.2018



Bedroom floor opening near the northwest wall. T. Mustonen. 29.03.2018

Opening B12

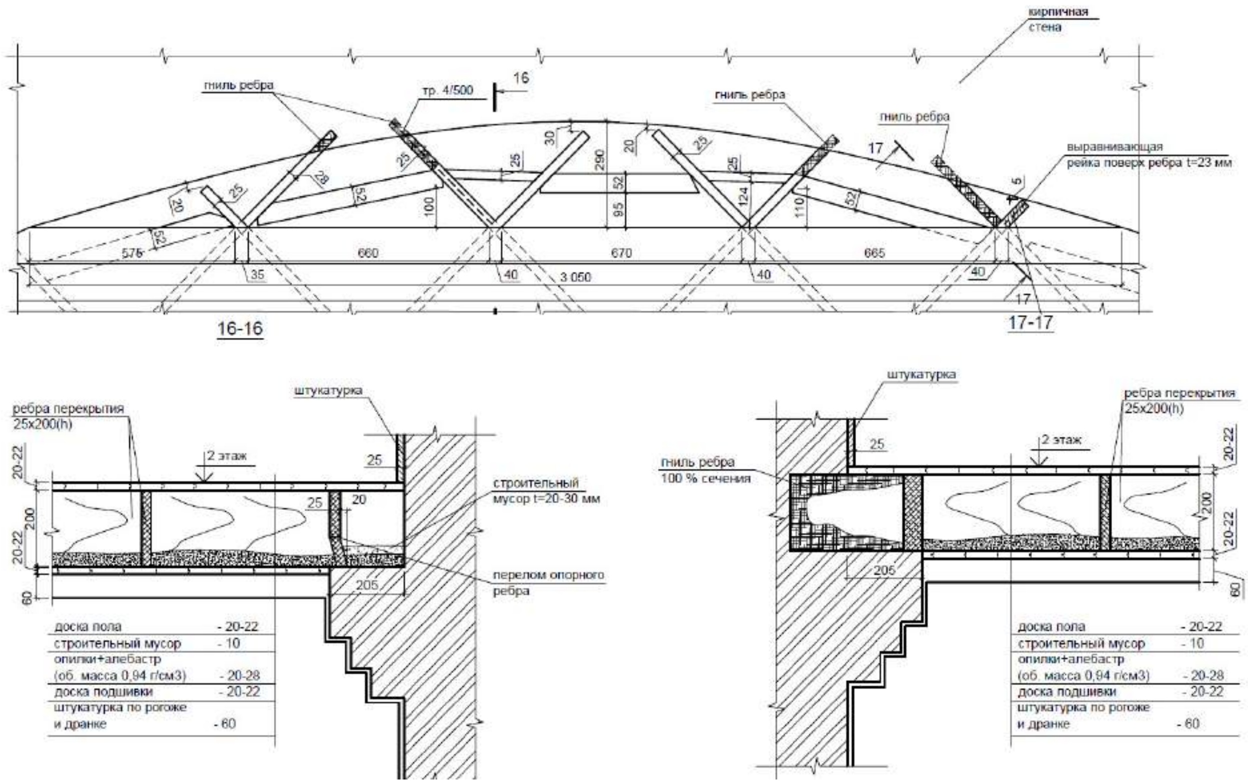
Location: near the northwest section of the wall in the bedroom on the first floor in the large cylinder. Three floor boards were opened near the wall. The floor boards are fastened with nails to joists of a wooden grid of the intermediate floor (nails are hammered on top). Filling, floor boards, supporting joists of the intermediate floor, and the ground floor ceiling boards were analyzed; the window opening (including its filling) was studied. The following samples of materials were taken:
- a fragment of a red brick;
- filling in the form of sand and lime mortar with sawdust;
- a fragment of light yellow paint;
- a sample of the wooden intermediate floor grid (for mycological research).

Inaccurately cut rim joist. Loosening of nailing.

General view. Short rim joists are made of thinner boards. Rim joists are above the inner brick cornice of the ground floor wall.

Thin rim joist is broken, probably because of the intermediate floor shift relative to the base.

Damage by rot of the supporting ends of joists of the ground floor grid. The only joists damaged are those, that are built in the masonry of the walls. In the photo: the joist is mostly peeled off from weak wood.



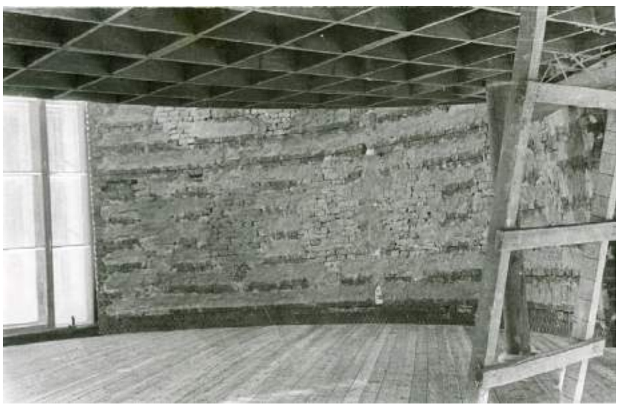
Opening B12. Bedroom. 1st floor

The intermediate floor of the first level

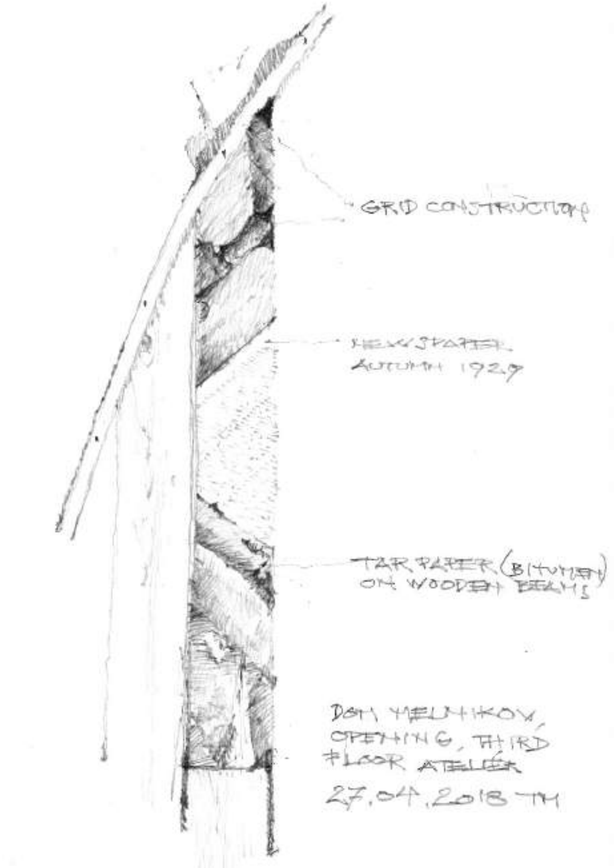
The intermediate floor of the first level is mainly located within the large cylinder, going beyond the volume of the living room of the small cylinder with a semicircular projection.

The intermediate floor is built in the exterior walls, and also transfers loads to the partitions of the first floor in the bedroom and the partition of the stairs in the living room. The grid of the intermediate floor is made of joists (200x25 mm each) with a 500x500 mm gap between them, notched out at half width and intersecting. The resulting joints are firmed with wooden wedges. The structure includes rim joists, bordering the grid on the supports, and the sheathing on both sides, made of the tongue-and-groove boards, which are laid diagonally at an angle of 45 degrees relatively to the grid; the boards on one side are perpendicular to the boards on the other side. The intermediate floor cells are filled with alabaster solution over a layer of tar paper, and newspapers with a thin layer of sand. The sheathing with tongue-and-groove boards forms the ceiling and the floor of the second and the first floors, respectively.

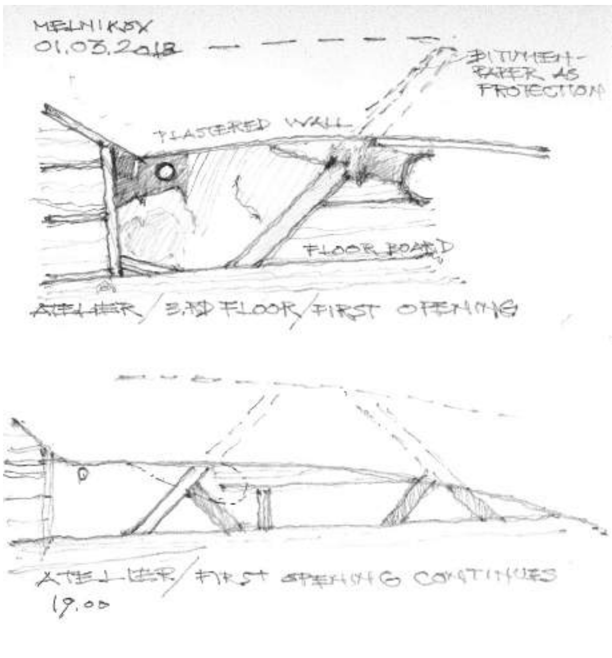
Only local conservation works of the studio floors were carried out during the restoration of the 1990s.



View of the intermediate floor of the first level, projecting into the living room. 1929



Floor opening in the studio near southwest wall. T. Mustonen. 01.03.2018



Floor opening in the studio near the northeast wall. T. Mustonen. 27.04.2018

The condition of the intermediate floor of the first level is partly operational.

According to the results of checking calculations, its bearing capacity is sufficient to take the existing constant loads and limited temporary ones from groups with a total weight up to 1000 kg. The following defects should be noted: significant deflection deformations (accumulative deflection from a constant load reaches 70 mm) and its increase because of temporary loads. As a result of intermediate level deformations, there are cracks over the ceiling of the first floor (including ones along the perimeter of the ceiling at the junction with the walls), deflections of the floor of the second level. The defects that create the prerequisites for reducing the rigidity of the intermediate floor include the weakening of the wedges that firm the joist notches, the worsening of the joint work of the joists because of lengthwise cracks in the joists at the level of the cuts, and the presence of irregularities in the joist flat surfaces (defect of construction work) and, consequently, sheathings do not fit tightly to the joists of the grid, which increase loosening of nailing. It is also important to note that the ends of the joists outside the rim joists were not accessible for inspection, but the general condition of this intermediate level is better than the one of the ground floor that is why one can assume less damage from rot was done to it.

The condition of the floors of the second level is unsatisfactory, primarily because of the presence of deviations from the horizontal, the deflection of the intermediate floor. It is also necessary to point out local damage to the tongue-and-groove boards, opening of the joints between them because of drying and interruption of their united work, local deflections of the floor boards, projecting sections of the boards not brought to the supports. When walking, the boards move, bend and creak. Traces of mechanical damage accumulated on the floors; there are places locally repaired in the 1990s.

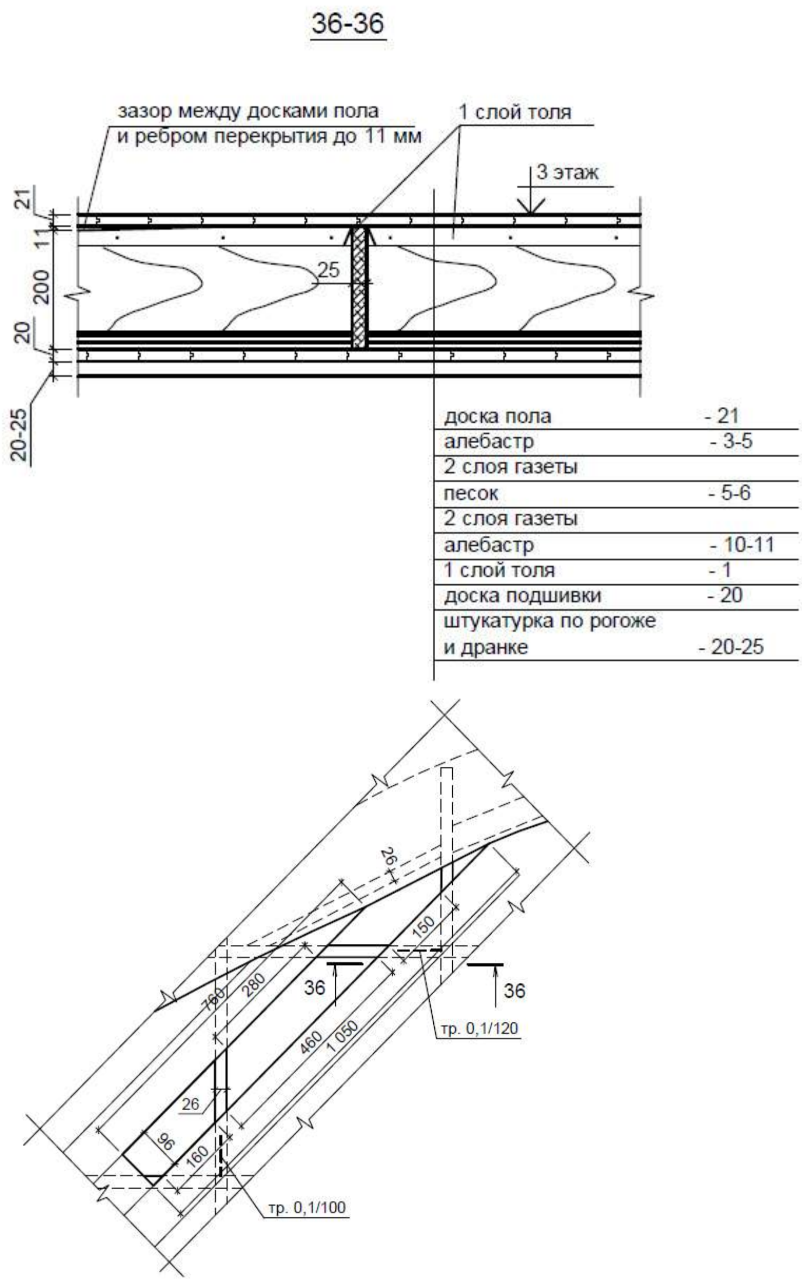
Opening B30

Location: a floor board was opened near the wall in the studio on the second floor to the west of the ventilation air duct. The floor boards are fastened with nails to the wooden grid of the intermediate floor (the nails are hammered into the tongue-and-groove joints). Filling, floor boards, joists of the bearing grid, and the ceiling boards of the first floor were surveyed. The following samples of materials were taken:

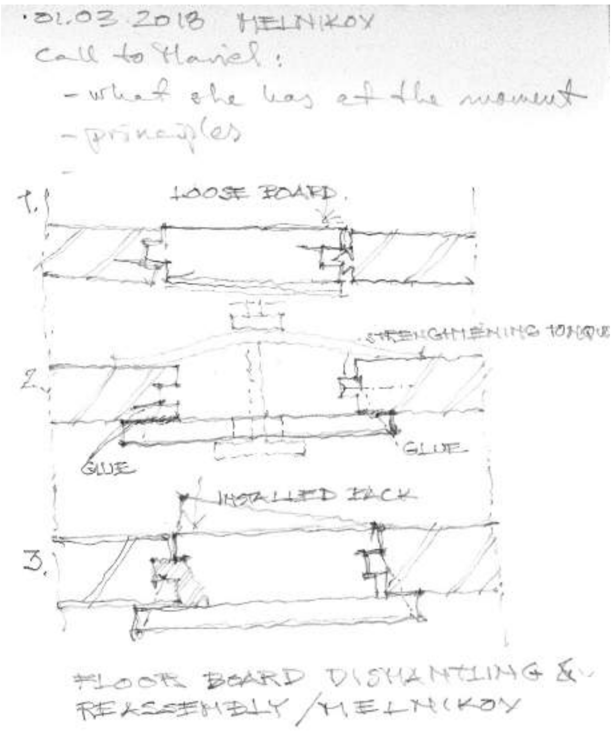
- filling;
- a sample of a wooden intermediate floor grid (for mycological research).

General view of the opening

Opening of the filling. Tar paper layer on sheathing, mortar, two layers of newspapers with sand filling



Opening B30. Section and plan



Dismantling and reassembling of the studio floor boards
Suggested and drawn by T. Mustonen. 01.03.2018

Roof of the large cylinder, general view of structures
Unevenness of insulation in the cells of the attic floor, presence of construction debris (scraps of tinplate).

Roofs

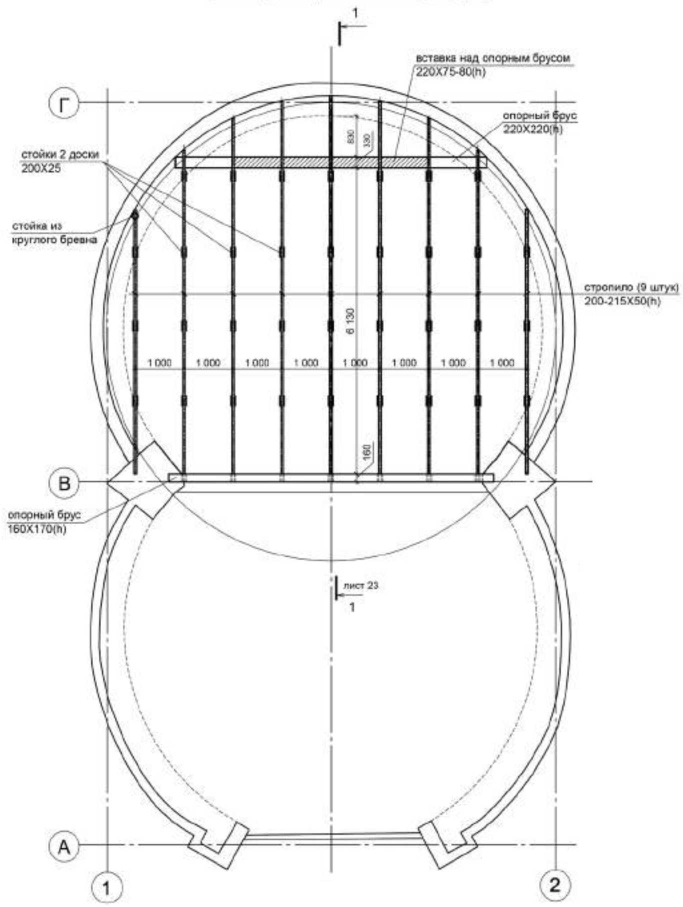
The roof of the large cylinder

The roof of the large cylinder and the attic floor joists were rebuilt with partial use of the original material in 1993. During the restoration of the 1990s, in addition to replacement of the original structural elements, the roof structures underwent some changes in sections, cuts and joints.

The roof of the large cylinder is single-slope (with a slope of approximately 13°), built of wooden trusses, the lower belt of which is formed of the attic floor edges. At the junction of two cylinders, between the terrace and the studio, a load-bearing wooden wall is arranged on which the edges of the attic floor are brought onto, and above the wall there is a peculiar frontal truss, the upper belt of which is the south supporting beam. The rafters are on the south and the north supporting beams, and the extending parts transfer the load to the north wall of the large cylinder. There is spaced sheathing, nailed on top of the rafters, with standing seam metal roofing over it.

The attic floor has a similar structure to the floors of the house, but differs in the height of joists (245 – 250x22-25 mm) and absence of upper sheathing. A thermal insulation filling is made of sawdust and swarf in the cells of the floor. The attic floor has a projecting part over the small cylinder, forming a roof overhang above its terrace. The lower sheathing of the floor forms both the ceiling of the studio and the roof overhang of the terrace, which are plastered over lath.

Схема стропил кровли большого цилиндра



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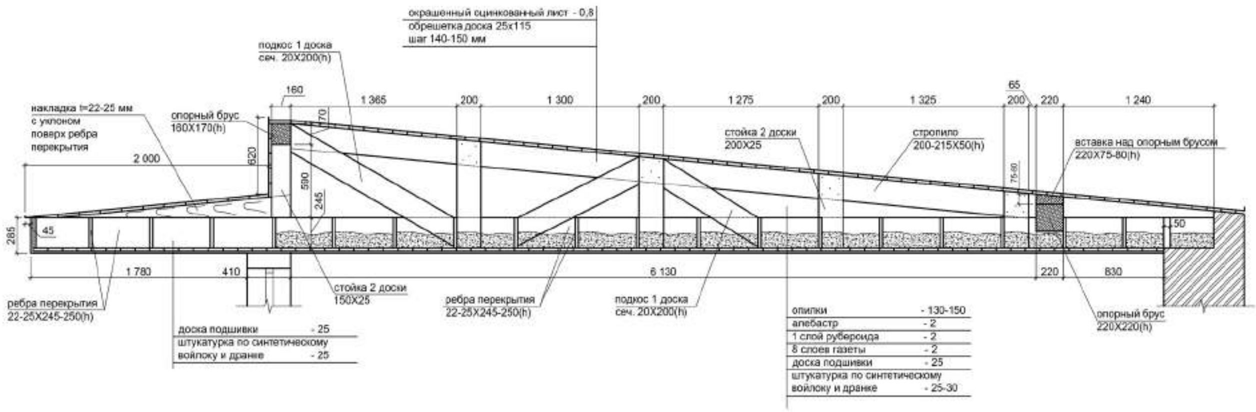


Attic floor of the large cylinder. Plan and section

View of a downspout from the roof of the large cylinder. There are places of water stagnation on the surface of the roof. The painting layers of the metal enclosure and the holders of the standing seam metal roofing are damaged; there is initial stage of corrosion.

The roof is made of painted metal tiles (seam type of roofing) on a spaced sheathing. Double lock standing seams of the roof run from south to north, double flat-lock seams are at the joints of sheets along the circle of the roof and soldered lap seams are at the joints of sheets along the circle and straight ones.

Drainpipe system is organized externally. The water drains into the west and east downspouts from the roof overhang. Water drains into the north downspout from the roof of the large cylinder.

The enclosure passes along the perimeter of the roof, and is made of single smooth metal rods, which are built in the masonry walls; a string goes through the loops on the top of rods.

The attic of the large cylinder is not heated. There is a small wooden door above the terrace overhang (with a ladder) of the roof to access the attic. There are small openings in the west and the east attic walls (leading to the north wall), which provide natural ventilation. Contrary to the K. Melnikov's project, one of the openings in the attic (from the northeast) was filled up in the 1990s. The temperature and humidity conditions of the attic are satisfactory.

In general, the state of the roof structures of the large cylinder can be considered as limitedly operational. According to the results of verifying calculations, the bearing capacity of the roof structures is sufficient to take the existing loads. However, the reduced structural rigidity (revealed by the tests) indicates excessive flexibility of the elements and joints and with the insignificant margin of bearing capacity of the roof elements, forces to limit the temporary snow load on the roof to the maximum allowable load of 100 kg/m². Thus, it is necessary to clean the roof of the large cylinder of snow without waiting for it to increase to the maximum allowable load (according to the current standards 210 kg/m²). This is a necessity for the further operation of the roof without interference.

The following defects should be noted: the insufficient rigidity of the roof structures, which is seen in the form of deflection of the ceiling in the studio, which reaches 80 mm as a result of the constant load and increases because of the temporary load. This deflection is the cause of cracks on the surface of the ceiling in the studio and it also forms places of water stagnation on the roof surface along with the local deformations of the spaced sheathing.

Second floor. Studio. Cracks in the plaster layer of the ceiling

Less significant defects should also be noted: local cracks and splits, lumber shrinkage, loosening of the wood surface of the remained original elements. There are boards with wanes and bark in places. The end surfaces of joists have excess waterproofing; they do not let moisture out.

It should also be mentioned that the attic floor has uneven insulation filling, significant amount of dust and construction debris.

In general, the roof is in satisfactory condition, however, there are a number of defects that impede its normal operation. The following were detected: moisture seepage to the wall near the downspout, water stagnation on the roof surface due to deflections of the spaced sheathing and roof structures, local bending of the coating, standing seams, and mastic sealant failure.

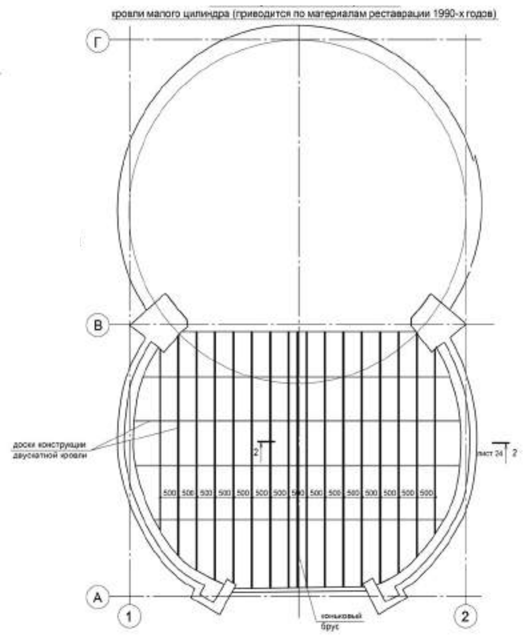
The original metal roof enclosure does not meet modern requirements and can be considered more like a decorative element. Its paint layer is lost in some places, there are signs of corrosion.

Attic floor filling. The original element is seen above – a rim joist with traces of moisture and more soft surface of wood.

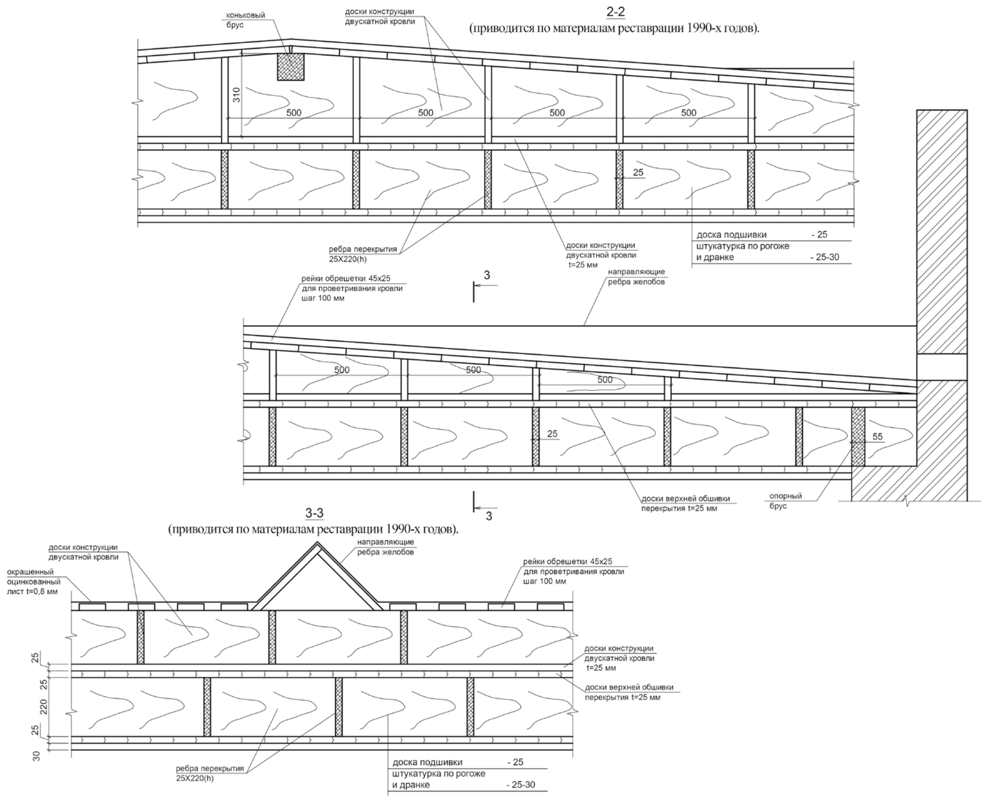
The roof of the small cylinder is subject to such live loads on the deck as snow, excursions and museum staff.

The roof disk is similar in structure to all intermediate floors of the House, but it has a difference in the height of the joists. It is a grid, made of intersecting joists with a cross section of 220x25 mm, which are sheathed on both sides with diagonal tongue-and-groove boards 25 mm thick. From the south the joists are cut out, where they meet the rail, and extend to the plane of the south façade, where the base of the façade inscription is attached to them. Besides, the joists run to the north and protrude, forming the mezzanine in the large cylinder. The cells of the grid are empty, with the exception of one south row above the rail, which is filled with a mixture of sawdust and mortar. The roof disk has hinge supports, they are the exterior walls of the small cylinder – along the contour, the rail – in the south, in the north the disk rests on the wooden truss and also transfers the load to the semicircular in plan partition of the first floor between the large and the small cylinders, the pillar and the box of the spiral staircase. The lower sheathing of the roof forms the ceiling of the living room and mezzanine in the studio, which are plastered over lath.

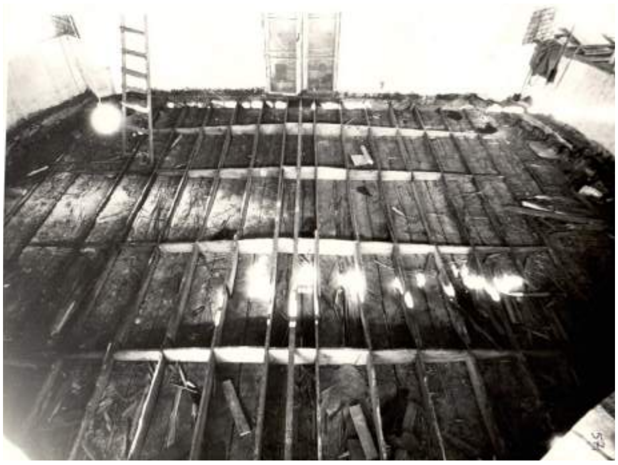
Over the covering of the grid there is a system of sloped joists and a ribbed structure on top of it, made of wooden boards and which serve as gutters of the water discharge system of the metal roofing.



The roof of the small cylinder. Plan.



Roof floor of the small cylinder. Sections.



General view of the sloped joists of the roof floor of the small cylinder before restoration work of the 1990s. 1993

The slopes of the roof are at an angle of about 2,5 degrees. The roofing is made of seam painted metal sheets with a thickness of 0.8 mm. Over the ridges of the water directing ribs there are double-lock standing seams; the rest joints are double flat-lock seams.

The drainpipe system is outside organized. Gutters run horizontally on the west and east façades then slope toward downspouts suspended near the junction of two cylinders (they are made of galvanized pipes).

The wooden deck is on top of the roofing. Above the large window, between the west and east walls there is a barrier made of two metal pipes and fixed into the brick walls (parapet), which also enclose the terrace.

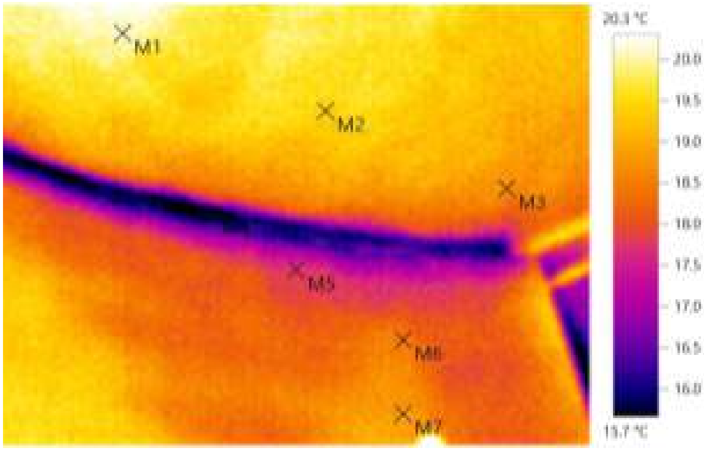
Roof of the small cylinder. Dirtiness of the roofing. The decking does not correspond to the author's design and the restoration project of the 1990s. Damage to the paint layers of the parapet.

There are four openings in the west and east walls of the small cylinder, which let air into the gap between the rim joists of the roof floor and the parapet. The rest holes are openings for the gutter, but along their perimeter, the space under the metal roof is also ventilated.

By the early 1990s, the roof floor of the small cylinder was in dangerous condition, and was subjected to fine-grained restoration (due to rot damage, individual joists and sheathing boards were replaced and strengthened), including the roofing and drainpipe system.

The general condition of the roof structures of the small cylinder is limitedly operational. According to the results of verifying calculations, the payload on the terrace flooring should be limited to 70 kg/m². That is, the excursion load is allowable, but it is necessary to clean the terrace flooring from the snow, without waiting for the load to increase to the maximum (according to current standards 210 kg/m²) – this is a condition for the following operation of the roof without reinforcing it. Accessible for inspection from vents and from the opening on the mezzanine of the large cylinder, the roof wooden elements are in a dry state and have no defects. By indirect signs, there has been no significant worsening in the state of the load-bearing structures since the restoration of the 1990s.

Among the defects, the insufficient rigidity of the roof structure should be indicated – consequently there is a deflection of the living room ceilings (accumulated from the moment of construction), reaching 100 mm, which is about 1/85 of a span. Under the temporary loads, the roof of the small cylinder also becomes deformed – deformations are of resilient nature and are transferred to the partitions below. As a result of these defects, there are cracks on the surface of the living room ceiling, which opened up after the restoration of the 1990s.



t °C	
M1	20.1
M2	19.5
M3	18.6
M4	15.5
M5	17.8
M6	18.3
M7	18.9

Thermal image. Fragment of the upper part of the southeast wall. 1st floor, the living room

Low temperature zone near the support area of the roof grid (along the edge of the ceiling). The temperature of the ceiling surface in the living room does not differ from the temperature of the ceiling surface in the studio.

Cracking of the façade inscription is also associated with the movement of the roof structures. The disadvantages of the roof include the lack of thermal insulation (or rather, the use of only an air gap for insulation), which allows small winter leakage and, accordingly, can contribute to the moistening of the roof wooden parts.

In general, the roofing is in satisfactory condition, traces of new leaks in the living room were not found. Among the defects, in addition to the initial weaknesses in the form of uneven seams, there is damage to the paint layer characteristic of physical deterioration, local bending of the roof floor, seams, loss of plasticity of mastics and loss of tightness of seams and joints to vertical structures, persistent surface dirt.

The wooden terrace flooring (2013) does not correspond to the K. Melnikov's design and the restoration project of the 1990s. The flooring is solid (non-separable) over the entire area, which makes it difficult to clean the roofing.

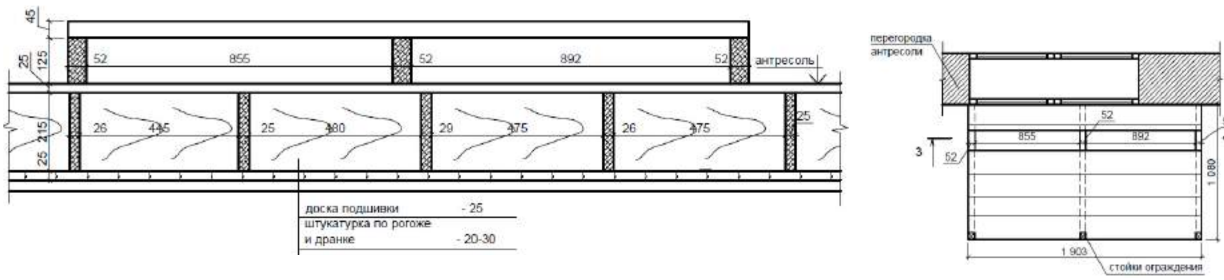
The snow melting system, installed in the 1990s, has been lost. Near the gutter openings in the enclosure snow clogs up the gutters and ice forms due to the temperature variations. Snow accumulates near the enclosure, on the gutters and from the inside of the terrace.

In some places downspouts and their fastenings have traces of corrosion. The metal barrier of the terrace has damage to the finish, cracks in the attachment points, the central wooden member is old.

The main defect of the ventilation system is the lack of the vents protection from birds and insects. At the time of the survey, they were clogged with materials brought by birds for making nests, which impeded ventilation (they were removed during the examination).

Opening B4

Location: the mezzanine in the studio in the second floor of the large cylinder. One floor board of the elevated part of the mezzanine was opened before the exit to the terrace and under the exit – the free part of the roof floor of the small cylinder, projecting into the large cylinder.
The boards are nailed over the floor battens, which create a rise relative to the rest of the mezzanine floor. The filling between the battens was examined and the upper boards of the roof floor of the small cylinder were opened. The joists of the grid were surveyed. The endoscopic examination through the chinks was also conducted.
Samples of materials were taken:
- a fragment of plaster mortar;
- paint over the plaster mortar;
- shavings, paper, wood chips, wood fragments;
- sample of the roof grid (for mycological research);
- a sample of a sheathing board of the terrace floor (for mycological research)



Opening B4. Mezzanine in the studio. 2nd floor. Section and plan

General view. Construction debris in the filling under the floor

View of the lower part of the truss. Its bottom chord, diagonal sheathing boards and plaster over lath are visible

Staircases

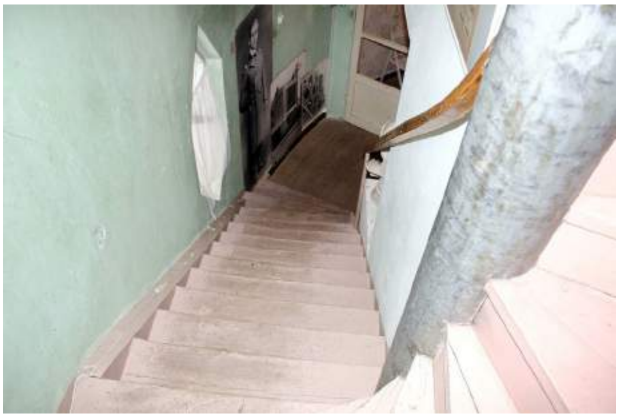
There are three staircases inside the house.

The stairs to the basement are monolithic reinforced concrete, supported by the intermediate floor rail of the basement and the exterior brick wall of the basement and the pillar of the inter-floor staircase; in the lower part the stairs are made of brick. The steps are coated with sand and cement compound.

The main staircase is a wooden one, built on stringers, having a straight run from the ground floor to the first floor and then becoming a spiral one with winders, and from the first floor to the second floor – a spiral staircase with an enclosure, made of plastered wooden partitions, and winders, organized around a central pillar. Wooden treads and risers are painted on the front and plastered on the back side above the intermediate floor of the ground level. The central pillar is made of a log, covered with tinplate, which at the level of the ground floor rests on a brick pillar, which has its own foundation.

Mezzanine stairs are straight and have one flight along inclined stringers (made of boards). Wooden handrails have rare posts.

Second floor. Studio. Cracks in the finishing layers of the ceiling under the mezzanine. The stairs to the mezzanine don't have enough posts (insufficient rigidity of the handrail) and have severe wear of the treads



Main staircase between the ground and the first floors. Deflection and deterioration of steps in passing places, wear out of the paint layer, insufficient rigidity of the handrail

Main staircase between the first and second floors. Cracks in the plaster layers of the stairs and its cylindrical partition.

View inside the heater room. The reinforced concrete stairs are on the right side and the absence of thermal insulation of the stairs and ceiling (tinplate sheets) is clearly visible

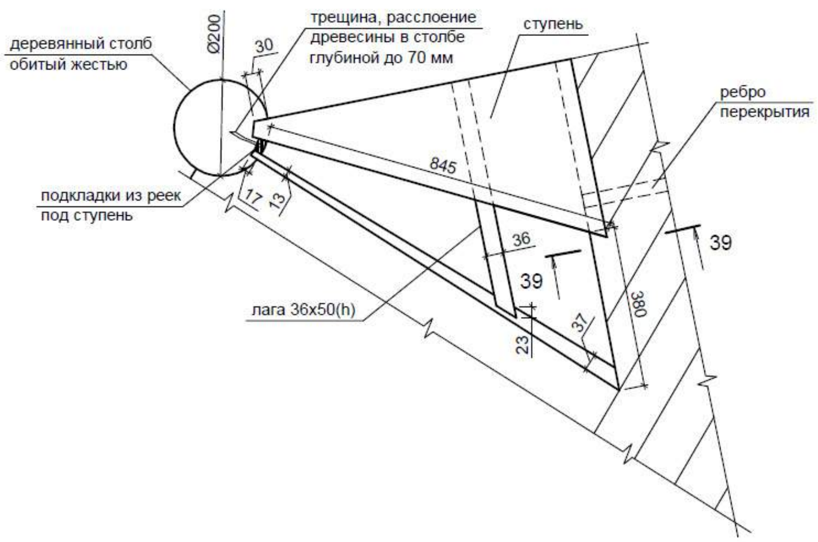
Basement, general view to the north. Cracks and detachment of the steps covering.

The staircases of the building are currently in limitedly operational condition. The bearing capacity of the central supporting pillar of the spiral wooden staircase of the building is ensured (15 tons comparing to 3 tons of the total weight of the group of visitors and the own weight of the staircase).

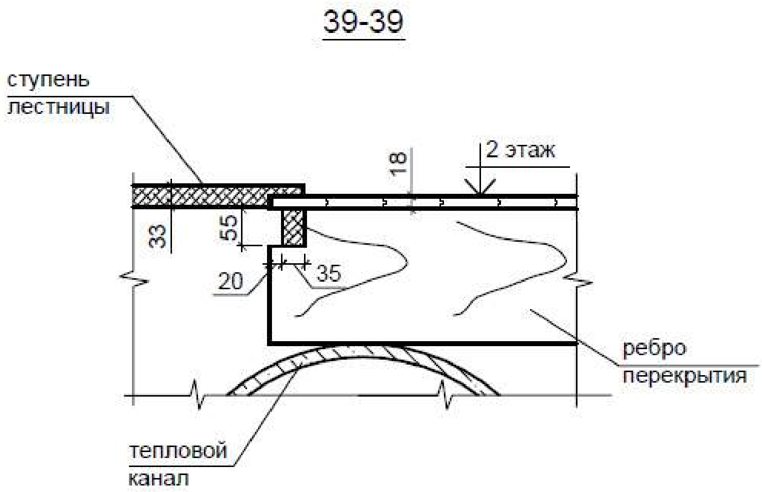
The stairs to the basement have defects mainly in the form of the coating detachment of treads and cracks in it. The main staircase has lots of cracks in the plaster layers; in some places the plaster layer has "void" sound when tapping, the paint layers have mechanical damage, the steps creak when walking, and have deterioration in passing places. The stairs to the mezzanine also have damage to the finishing layers, the deterioration of the wood steps in passing places. Steps and stringers of wooden staircases, as well as handrails have insufficient rigidity.

Opening B33

Location: the main staircase, the first floor. The step of the staircase was opened, its structure analyzed, and a sample of painting is taken.



Opening B33. Main staircase. 1 st floor. Plan



Opening B33. Main staircase. 1st floor. Section

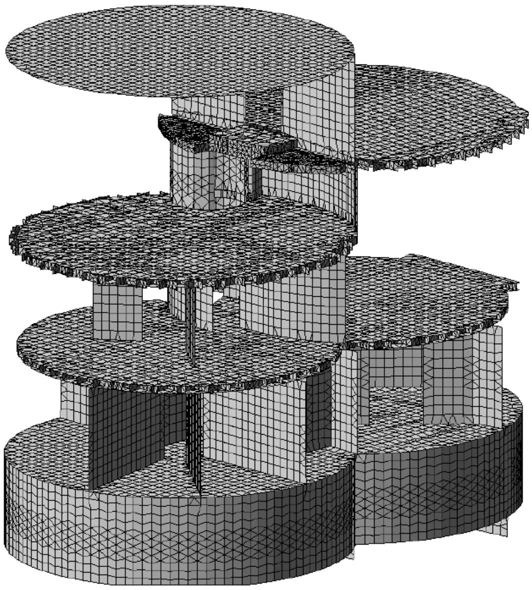
General view. A reinforcing board is seen near the center of the tread, running from the partition under the stairs to the riser. The insulation of the heating air duct is on the

Central pillar supports the tread and the riser – leveling strips are left on the riser. The pillar has shrinkage cracks. A partition under the right side

Space under the tread. There is a supporting board between the tread and the floor boards on the right

View of the steps from the inside. Treads rest on risers through leveling strips, nailing is loose

Load simulation: computer modeling and testing

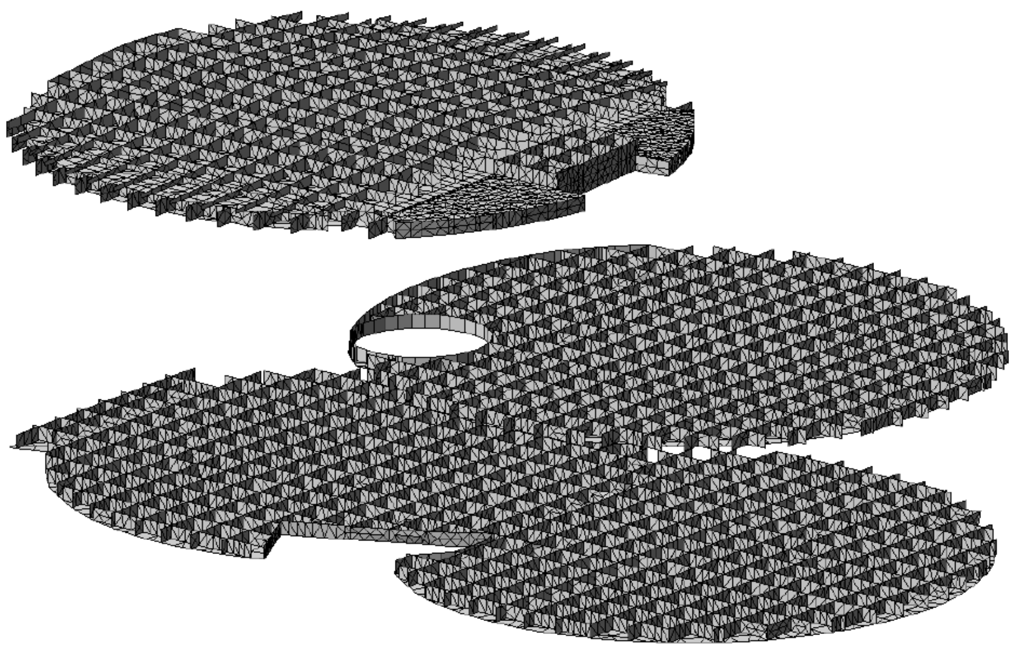


Finite element joist model of intermediate/roof floors and partition walls of the building

The purpose of the research is to determine the maximum allowable load of excursion groups on the house structures, including the wooden intermediate/roof floors. It was carried out in 4 stages:

Stage 1

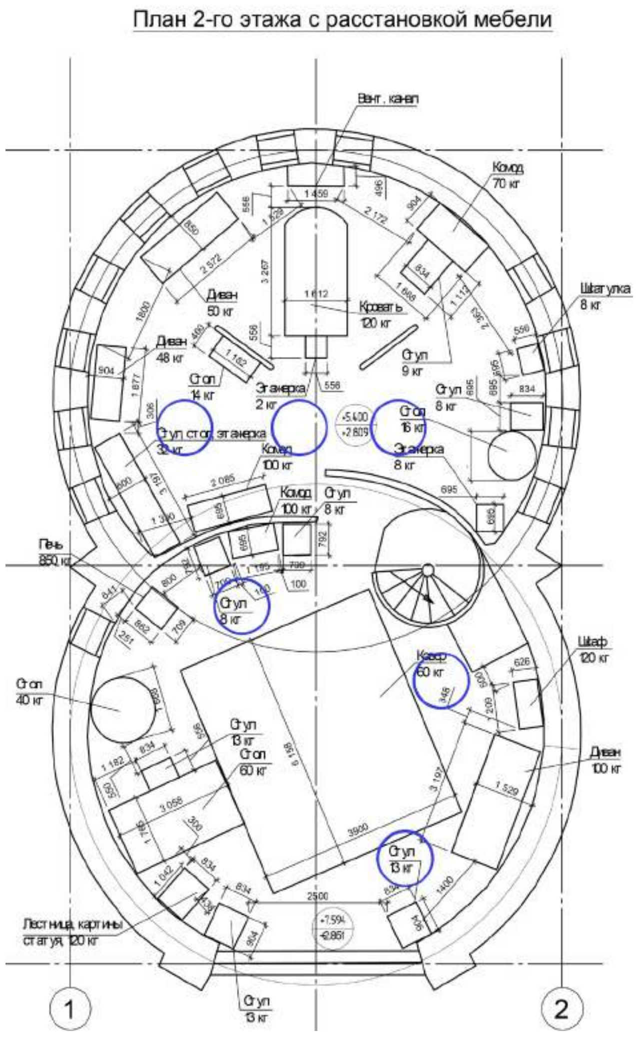
A spatial finite element model was built and calculated, it was divided into elements with the size of 300x300 mm each, using quadrilateral meshing. Calculations were made on the basis of current standards for housing (150 kgf/m²) with a safety factor of 1.3 (195 kgf/m²). The technical condition of the intermediate/roof floors is assessed as not operational due to their insufficient toughness and rigidity. Computational results for deflections are more than the maximum allowable standard limit (24.6 mm). The absence of structures deformations is explained by the fact that the real points of loads and their actual intensity differ significantly from the theoretical load through the entire surface of the intermediate floors.



Cross system of floor joists of the joist model at heights of 2.95 m, 5.85 m and 8.44 m

Stage 2

To assess the actual distribution of stresses and deformations, the model was adjusted based on the actual dead and live loads. Dead loads are the weight of the structure itself furniture items in the interiors, and the weight of the wood burning stove (850 kg) in the living room on the first floor. Live loads, applied to the intermediate/roof floors, include the load produced by the weight of visitors (880 kg per 4 m²) and the snow load on the roof (210 kgf/m²).



Plan of the first floor at a height of 2.95 m with the arrangement of furniture and areas of distribution of visitors

The calculations were made on the basis of the finite element model with respect to all the building structures (walls, partitions and intermediate/roof floors).

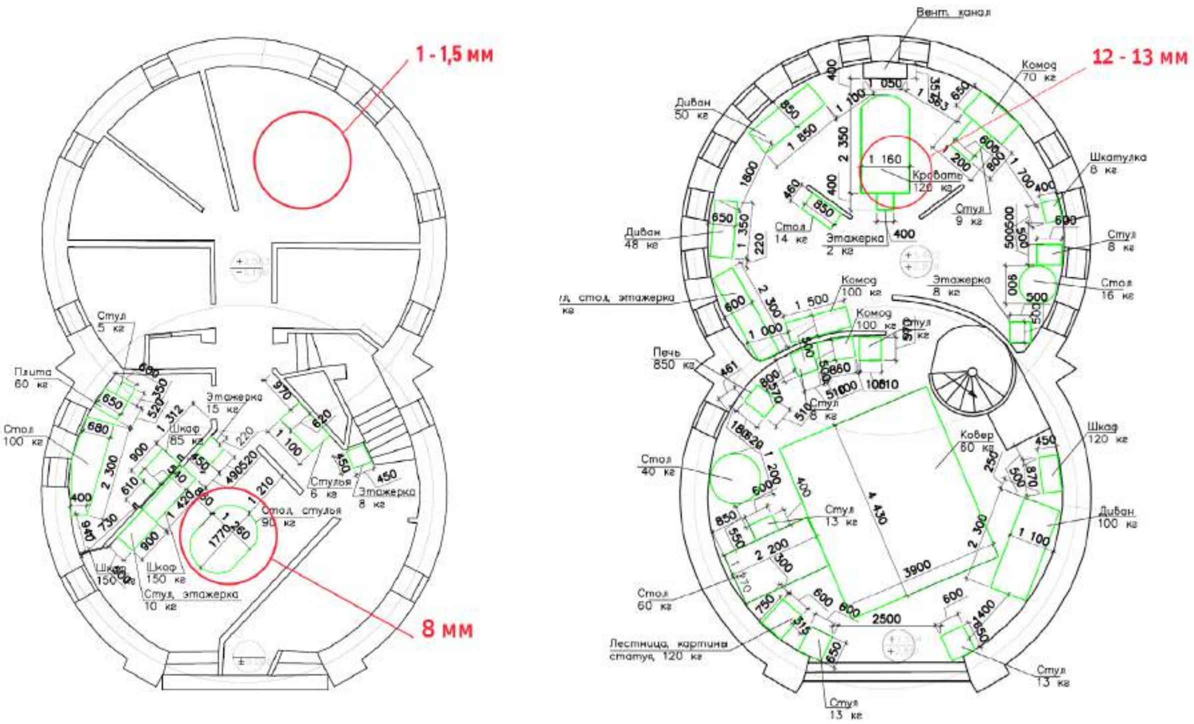
However, the computational results for deflections of the building floors at heights of 2.95 m, 5.85 m and 8.44 m exceed the maximum allowable values (24.6 mm), therefore, the condition for the rigidity of the intermediate/roof floors fails. At the same time, the maximum bending moment in the intermediate/roof floors of the building at altitudes of 2.95 m and 5.85 m does not exceed the maximum allowable value, that is, the bearing capacity of the intermediate/roof floors is insured. The maximum bending moment in the intermediate floor of the building at a height of 8.44 m slightly exceeds the maximum allowable value that determines the bearing capacity of the intermediate floor. The technical condition of the wooden intermediate floors is assessed as partially operational.

The toughness and bearing capacity of the most loaded wooden partition (1st floor of the large cylinder) are insured with a margin. The stress in it is 18.416 kgf/cm² and does not exceed the obtained wood strength properties (100 kgf/cm²), therefore, the toughness and stability of the partitions when exposed to the weight of visitors is provided. It was found that the load of a short duration must not exceed 1000 kg.

Stage 3

The intermediate/roof floors were tested with a load of 880 kg, which was compactly distributed in several areas of each floor, with simultaneous high-precision geodetic measurement of their deflection.

The maximum additional short-term deflection of the intermediate floors are as follows: of the ground floor (in the dining room) – 8 mm, of the 1st floor (in the bedroom) – 12 mm, of the 1st floor in the center of the living room – 3 mm to the existing 65 mm of constant deflection, of the 2nd floor in the center of the studio – 14.8 mm to the



Areas of maximum deflection of the intermediate floor of the ground and 1st floors on the basis of field tests

existing 35 mm of constant deflections.

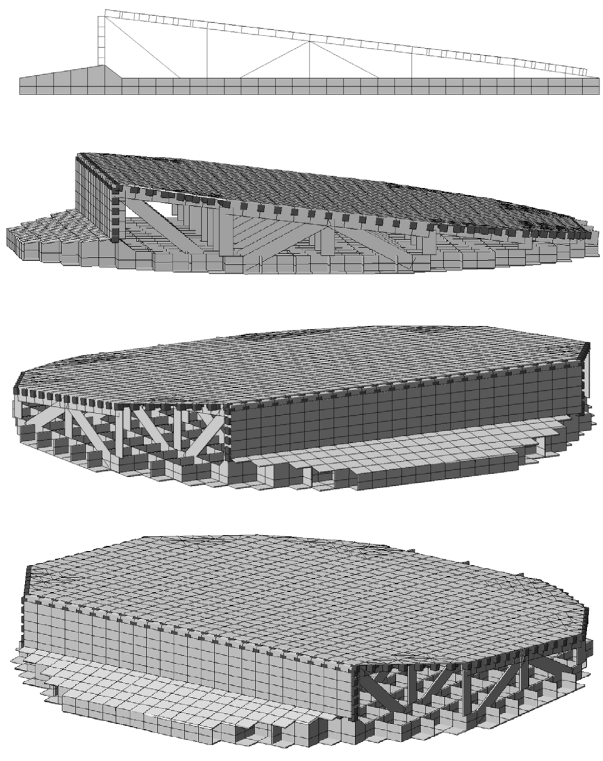
The tests with the load of short duration revealed that the intermediate/roof floors of the building are resilient, that is, their deformations (deflections) disappear after the removal of the load.

Stage 4

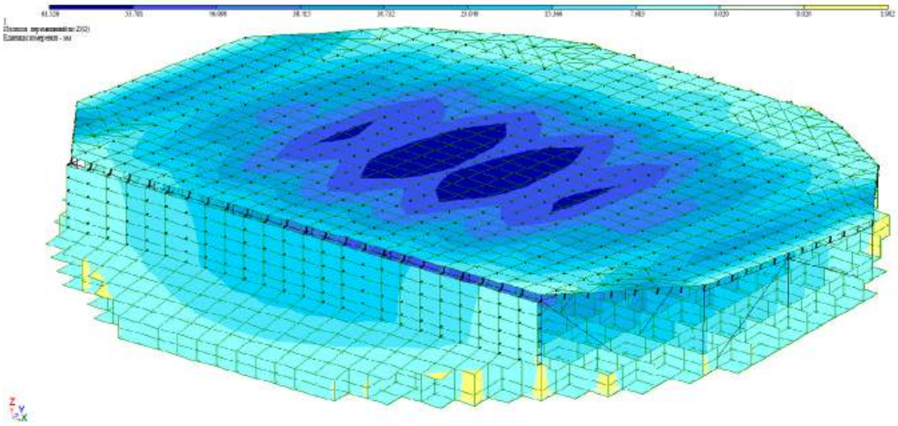
At the final stage, the intermediate/roof floors stiffness characteristics were obtained, which are equivalent to the actual ones. The load of 880 kg, uniformly and compactly distributed through the arears of intermediate/roof floors 4 m² each, was introduced into the computational model.

Based on the intermediate/roof floors stiffness data, the final adjustment to the computational model was made using correction factors on the test results.

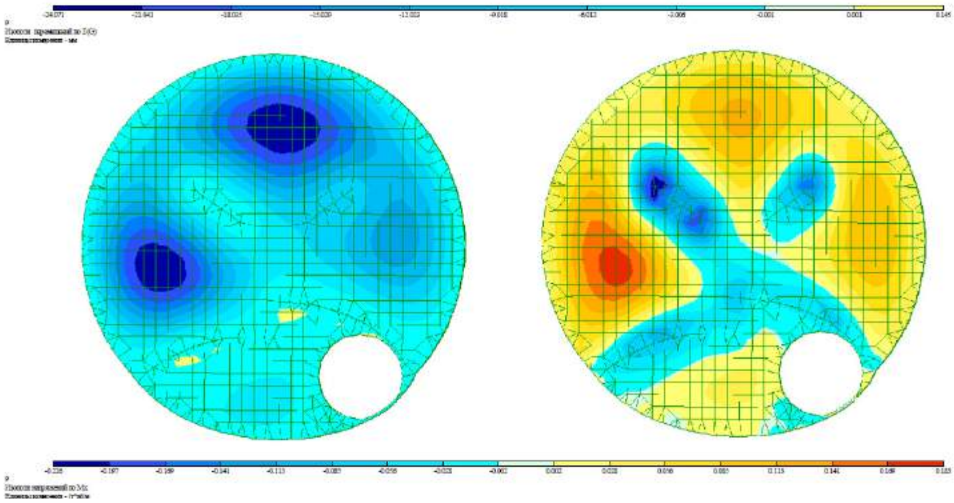
As an illustration, here are several plots of deflections and stresses in structural elements.



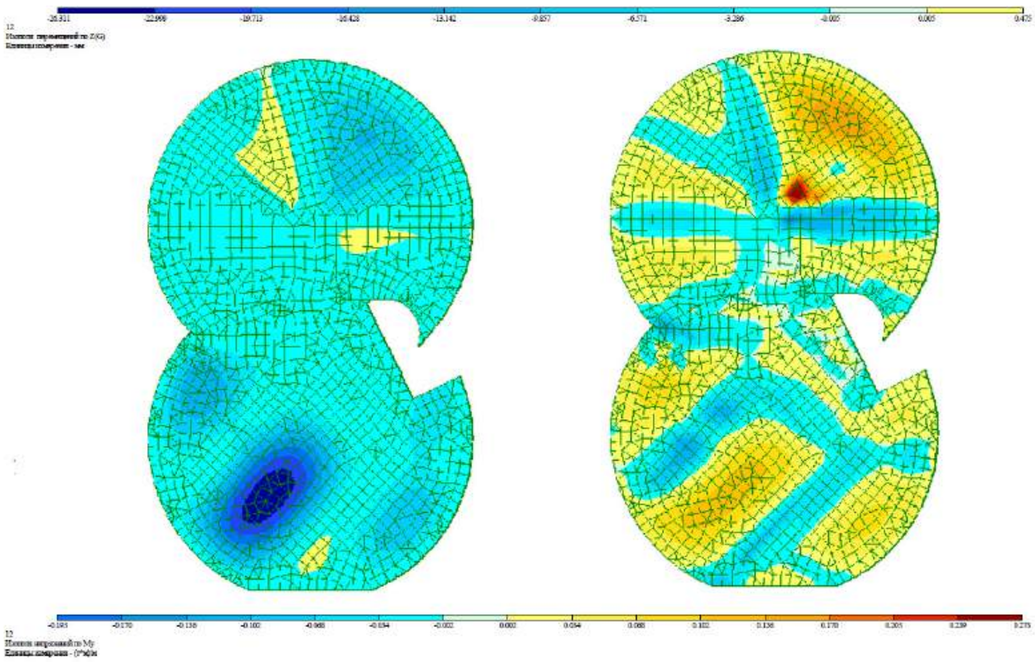
Roof structure of the large cylinder



Roof floor deflection at a height of 10.64 m from the weight of structures and snow



Intermediate floor deflection and bending moment Mx at a height of 5.85 m from the weight of structures, interior items and visitors



Intermediate floor deflection and bending moment My at a height of 2.95 m from the weight of structures, interior items and visitors

Calculation of stress in separate structural elements revealed the following:

1) Bearing pressure, that the footing exerts on the soil (1,5 – 1,8 kg/cm^2), does not exceed the soil shear strength parameters 2.25 – 5.69 kg/cm^2. The calculation of the deformations showed that the footing is wide enough for the applied and anticipated loads.

2) The maximum stress in the rubble masonry of the foundations of the building (2.79 kgf/cm^2), obtained as a result of the calculation, does not exceed the average calculated resistance of the rubble masonry to compression (5.5 – 6.0 kgf/cm^2). This means that the bearing capacity of the foundations of the building is insured.

3) The maximum stress in the most loaded level of the lower row of brick walls in between the windows does not exceed 60.83 tf/m^2, with the maximum allowable stress of 153 tf/m^2. The bearing capacity of the external bearing walls of the building is provided. The bearing capacity of the ground floor brick posts is insured, stresses in them are 7 times less than their bearing capacity.

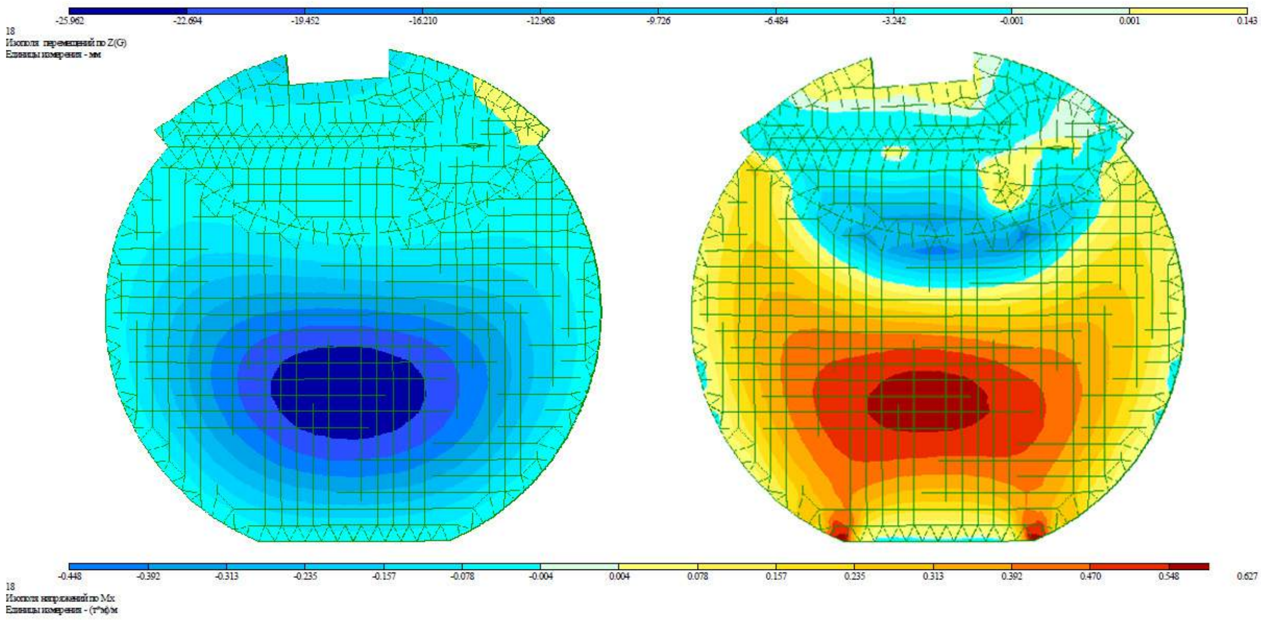
4) The bearing capacity of the central pillar of the spiral wooden staircase is insured.

5) The toughness and bearing capacity of the reinforced concrete intermediate floor of the basement is insured.

6) The bearing capacity of the intermediate floors at levels 2.95 m and 5.85 m is sufficient to allow their use under loads from their own weight and the weight of visitors. A one-time stay of a group of 8 – 10 people is acceptable.

7) The presence of a group of visitors, weighing no more than 1 ton, on the first floor (height 2.95 m) leads to a slight increase in the ceiling deflection by 1 – 2 mm maximum, owing to a large number of partitions on the ground floor, involved in the work.

8) The presence and movement of a group of visitors with a load of no more than 1 ton on the 2nd floor (height 5.85 m) leads to an increase of the intermediate floor deflection of no more than 14.8 mm. Taking into account the existing deflection of the intermediate floor at a height of 5.85 m within 35 mm, the total deflection, caused by the dead load and the live load from a group of visitors, will be no more than 49.8 mm. That exceeds the maximum allowable



Intermediate floor deflection and bending moment Mx in the intermediate floor at a height of 8.44 m from the weight of structures, interior items and visitors deflection for an intermediate floor with a width of 8.6 m, which must be no more than 1/350 of a span, i.e. 24.6 mm.

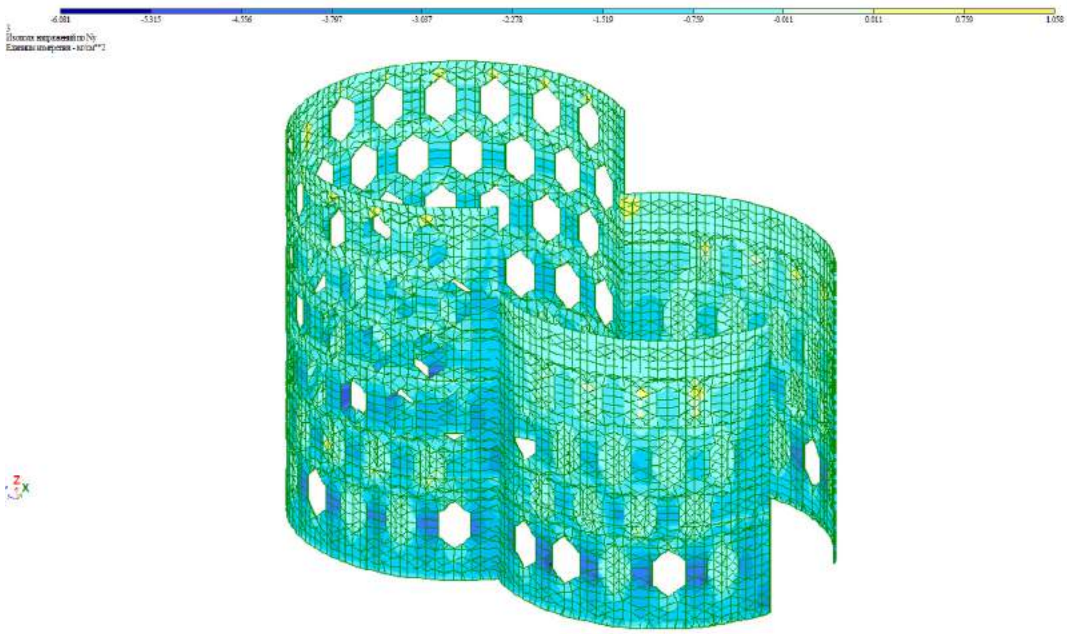
9) The tests revealed that the deformations of the intermediate floors of the building, appearing from a short-term load, imitating the excursion group, are of a resilient nature. Thus, a load of short duration from the excursion group, weighting 1 ton, distributed through an area of at least 4 m^2 of an intermediate floor, is recognized as allowable for the safe operation of the building.

10) The maximum calculated moment in the roof structure of the small cylinder, caused by its own weight and snow load is 1.142 tm, which exceeds the maximum allowable moment in the ceiling (M = 0.85 tm). When operating the terrace of the building it is necessary to prevent full snow load. As for the toughness, the maximum allowable snow load on the terrace of the building is 70 kgf/m^2.

11) Based on the results of a separate computational finite element modeling of the roof structures of the large cylinder, the bearing capacity of the structures (the upper belt of the roof trusses, the northern and southern supporting beams, the terrace canopy, etc.) for the snow load is ensured. However, the bearing capacity of the attic trusses is ensured at the limit of toughness. On the basis of the deflections, identified during the testing, and also taking into account the uncertain nature and quality of the nailing of the roof elements and the insignificant margin of toughness of certain parts, it is necessary to clean the terrace overhang and the roof of the large cylinder from snow in time. The maximum allowable snow load on the roof of the large cylinder is assessed to be no more than 100 kgf/m^2.

On the results of calculations and tests attention should be paid to the following recommendations:

- The maximum allowable load from an excursion group is 1000 kg.
- The terrace and the roof of the large cylinder of the building should be cleaned from snow in good time.
- It is necessary to monitor the state of the supporting structures due to low bearing capacity margins of the wooden structures and to the already existing excess of allowable by standards deflections of structures, weakening of the finishing layers (cracks in plaster) and predicted flexible deformations of structures when exposed to temporary loads (weight of visitors).



Contour plot of the stresses in the brick walls from the weight of structures, snow (210 kgf/m^2) and visitors at a height of 2.95 m

Structure materials testing

During the testing of brick, metal and iron-concrete materials, using non-destructive methods, the following toughness indices were determined:

- External walls (brick M100 – M125, mortar M50): the toughness of the masonry ≈ 1.5 MPa.
- Rubble foundations (limestone M100 – M250, sandstone M200 – M300, mortar ≈ M25): the toughness of the masonry from rough-hewn stone ≈ 1.68 MPa, the toughness of the masonry from rubble stone is 0.55 – 0.6 MPa (taking into account the soil compaction of 0.65 – 0.7 MPa).
- Basement walls, remained from a previous building (brick M75, mortar M25): the toughness of the masonry ≈ 1.1 MPa.
- Partitions of the heating room (brick M100, mortar M10): the toughness of the masonry ≈ 1.0 MPa.
- Basement intermediate floor: concrete B15.
- Foundations of the ground floor partitions: concrete B20, reinforcement with bars of AIII class.

High-presision measurements of inter-floor deflections

Checking the opening on the west façade

Bricks toughness testing

Materials

Mycology

Fungi are present in many wooden parts of the house owing to a number of shocks in its history such as II World War period when the house was not heated for a long time. Mycological report contains photos, floor plans with points of where samples were taken, qualitative (types of fungi) and quantitative (colony forming units, CFU) results of the analysis.

Inter-floor structures damaged by rot. Bedroom, 1st floor

Enlarged fragment of the above image

Specialists on fungi collected most of the samples from the openings made by structural engineers. A total of 58 samples were obtained and analyzed in laboratory (40 samples inside the building: floors, intermediate floors, window frames, insulation filling of the locked apertures in the exterior walls, and 18 samples outside: external frames of windows, attic, wooden shields covering apertures in the walls).

· Generally, CFU level is low (10 – 150 per dm^2) and under control.

· The house has local areas of old biodegradation. They require point repair and restoration, as well as bioprotection.

· In the openings traces of vital activity of wood-decay fungi were found in the form of rot, however, viable fungi were not found.

· In the roof structures serious damage with a significant loss of strength (dangerous) was not fixed.

· The plaster layer of the façade has areas of biodeterioration and salt corrosion, requiring biocidal treatment.

· Areas of salt corrosion were found in the basement, biodeterioration there is moderate.

· External window frames have local areas of rot with a loss of strength. This implies either replacement or their repair in the affected places.

· Intermediate floors in the bedroom (between the ground floor and the first floor) as well as the lower part of the large window in the living room are most damaged by fungi places (CFU level 1500-2000 per dm2 or higher). The wood of these intermediate floors has local areas of rot with a complete loss of strength, which implies entire or partial replacement of damaged parts of structures. It is recommended to replace or to treat the soundproof filling of the intermediate floor. New, replaced parts and old wooden structures should be treated with a bioprotective agent.

· Another big issue is hexagonal wooden shields under paint and plaster layers, covering the 3rd, the 4th and the 5th rows of hexagonal apertures, filled with insulation and locked in the course of construction in 1927 – 1929. The wood of the shields is dry but soft and rotten, and it is a potential source of microorganisms growth. One of the issues for future conservation project is to leave them as they are now (focusing on plaster strengthening) or to replace them with obvious loss of material authenticity. The insulation filling itself contains high level of fungi.

Preservation of biodeteriorated materials is possible by their conservation using chemical biocides or creating conditions that will prevent the growth of microorganisms. Recommendations are given about cleaning and treatment of particular wooden areas by biocides.

As a 'soft measure' control over temperature and humidity inside the house throughout the year is highly recommended. It should be noted that any significant wet works in the house (e.g. conservation works) may trigger and become immediate reason of uncontrollable fungi growth at the areas mentioned above.

Types of fungi found in the Melnikov House:

- Acremonium charticola
- Alternaria sp.
- Aspergillus niger
- Aspergillus sp.
- Cladosporium herbarum
- Cladosporium sp.
- Geomyces sp.
- Mucor racemosus
- Mucor sp.
- Paecilomyces sp.
- Penicillium sp.
- Phoma sp.
- Rhizopus sp.
- Trichoderma sp.
- Ulocladium chartarum

Bottom of the studio window (top row). Destruction of the paint layer, the wood is damaged by surface rot.

Rotten wooden schield covering hexagonal aperture in the outer brick wall. West façade of the small cylinder.

Colony-forming units, CFU per dm2	Concentration level of fungi
‹ 100	Normal
100 – 1 000	Higher than normal
1 000 – 10 000	Very high
› 10 000	Extremely high

Building materials and technologies

179 samples of building materials from inside and outside (plasters, bricks, mortar, paints, insulation mix in the locked apertures) have been taken. The sampling of building materials partially follows the list of openings, made by structural engineers, but it has also its own logic and cover larger areas. Complete technological and building materials report contains photos, floor plans with points of all samples taken, qualitative and quantitative results of laboratory analysis, including:

- type of binder
- compressive strength (MPa)
- water absorption (%)
- effective (open) porosity (%)
- bulk weight (g/cm³)
- aggregate sand curve
- binder/aggregate ratio (for mortar and plaster)

Bricks. During the construction of the house, two types of bricks were used, red and orange with the compressive strength 16 – 26 MPa and absorption 12.5 – 14.0%. For two outflow ducts, a better and more expensive red 'gzhel' brick was used, since the unpainted brick chimneys are important visible verticals of the east and west façades. All masonry and bricks themselves are in sound condition. Bricks, used by K. Melnikov, are visibly different from bricks in underground fragments of walls remained of previous buildings on this plot of land.

The rubble stone, from which the foundations are made, is limestone with a relatively low strength of 8 MPa, low absorption of ~ 5.3% and low porosity of ~ 11.8%, it has much effloresced.

As there are no serious issues with masonry, focus of research was on plasters and paints.

Masonry mortar:

- in the basement on a cement binder
- in the studio on a lime binder
- on the façades of the building – heterogeneous, made of lime (strength 6 – 7 MPa), lime with cement (4 – 5 MPa) and cement (5 – 8 MPa) binder.

Sampling the paints in the dining-room. Ground floor

Collected samples from the opening on the west façade of the small cylinder

Filling-up of the hexagonal aperture. There are inclusions of broken brick of various sizes, coal, pieces of broken home-made ceramics, shells. The composition is close to the filled-up soil in the pits outside the house and under the foundations of the interior partitions.

The quality of the lime mortar is high due to the use of high-quality lime with good aging in a pit during the construction of the house. Masonry mortars are dense with low porosity.

Plaster compounds inside the house vary greatly in appearance, type of mineral binder, structure and properties. Although all plasters are lime-based, both pure lime binder and lime with the addition of gypsum up to 15%, lime-gypsum with gypsum content from 15 to 60% and even pure gypsum plaster were used. The cement binder is only on the bottom of the lobby wall. The more complex the surface shape, the higher the gypsum content in the mixture, added to increase the plasticity of a material (for example, the rounded decoration of the bedroom contains 35% of gypsum, a thin cylindrical enclosure of the staircase has 42 – 48% of gypsum). Almost all samples from the house showed that plasters inside are weak and fragile (1.2 – 1.8 MPa). They are in need to be strengthened, especially towards temporary (dynamic) external factors (visitors, temperature and humidity).

The façades plaster mixes were hand-made right on a construction site in 1928 – 1929 and they differ in physical and chemical characteristics. Besides, the plasters are heterogeneous in type of a binder and were made with application of different quartz aggregates, having the compressive strength of 1.2 to 5.0 MPa for the lime composition, which is the main component for the facades finish. Numerous areas of previous repairs using plaster mixes are with a high cement content.

Gradation test of aggregates has been done and as a result one can build 'sand curves' (size distribution and types of sand grains in the plaster: 'river' means round or 'mountain' means sharp) for different types of plaster used. It provides a proper information basis for further plasterworks in course of coming conservation works, especially for façades.

Inside the intermediate floors a very light porous

Openings of the façades

insulation material, made of mix of saw dust with limewater, was found. In addition to that full pages of newspapers (dated May 1929) were accurately put on top of this insulator with small amount of sand over it for weight. There is a hypothesis that K. Melnikov used sheets of newspapers as inexpensive hygroscopic material to absorb humidity from the wooden structures of the floor grids.

The filling of hexagonal apertures in the walls, embedded during the construction was also surveyed. Samples were taken from openings inside and outside the building. Inside and outside the building, all apertures are bricked-up with a thin layer of 1/2 previously used brick (possibly found from a previous building during excavation in the fall of 1927). Between these thin walls there is loose material, a mixture of sand and clay (and partially small pieces of construction debris) with a predominance of the first and a high air content between particles, which explains the minimum heat loss in the cold season. From the third row from the ground and above, outside the apertures are closed with wooden shields with layers of tow and lath for better adhesion to the plaster (see details in the chapter on engineering openings). The heterogeneity of the thermal characteristics of the façades materials partly explains the numerous cracks in the plaster.

Technological and building materials report gives basic analysis and explanation of paints used for color scheme on all three floors (natural pigments, chalk-based with small amount of organic glue added). An in-depth survey of paints and colors, including stratigraphy, has been done by the team from the Dutch Cultural Heritage Agency (Amsterdam) with special attention to the paints and colors of 'golden bedroom'.

Opening of the floor. Bedroom. 1st floor

Networks

Heating and ventilation

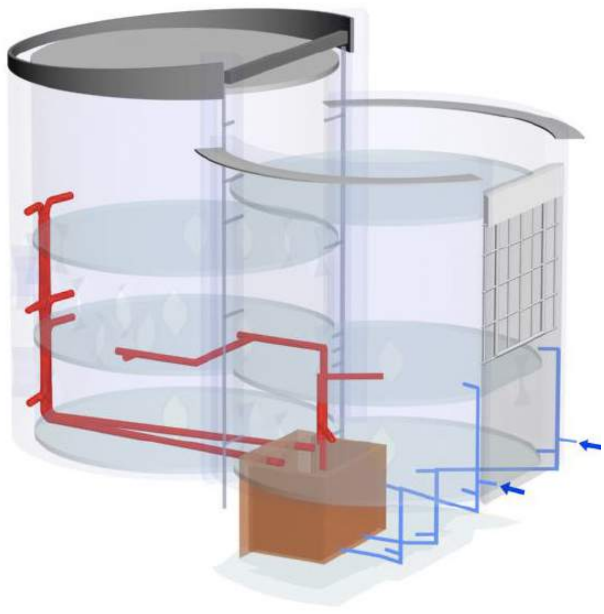
Existing heating system has been surveyed and described in the report with floor plans, axonometries and photos. The Melnikov House is interesting for its unique authorial system of the heating recirculation, which functions to this day. Over the years it has nevertheless been subject to major alteration, from stove (fueled by anthracite coal) to hot-air/hot-water heating connected to the citywide utility networks. However, the original ventilation arrangement and the heating ducts have survived.

Heating system in the house is not automated and it uses ventilation structures for heating: heating and ventilation air ducts are the same. It is a low-tech system which employs:

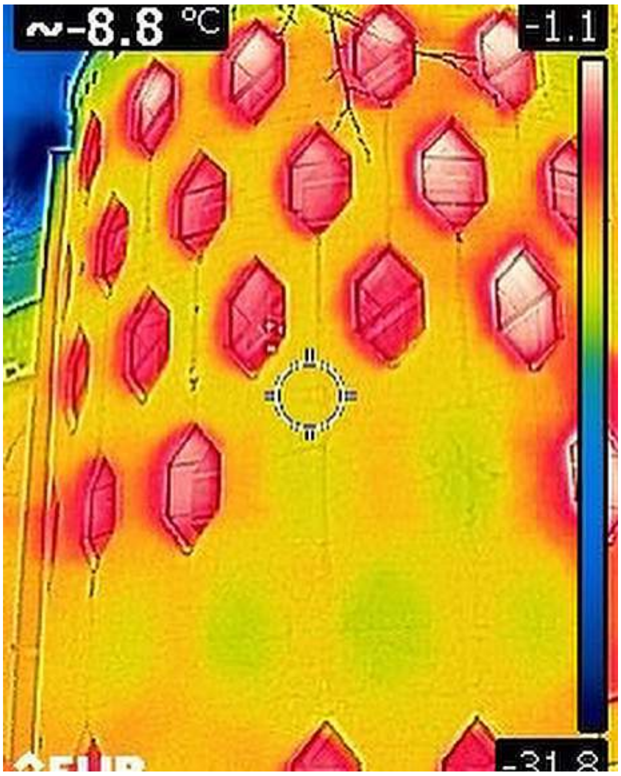
- central heating supply from municipal supplier,
- a large water-filled heating radiator in the basement
- an authentic layout of ventilation air ducts: (1) five air ducts inside the House made of roofing metal for delivering hot air to all floors and rooms, (2) two vertical brick air ducts (originally chimneys) for air outflow at the points of intersection of both cylinders, (3) two vertical brick air ducts along the main façade with exterior vents for air supply and interior vents for air recirculation.
- vents with grilles and louvers at the entry points of cold fresh air to the house and exit points of hot air to the rooms.

Air moves around the house by natural way due to temperature difference and, accordingly, the volumetric air weight before entering the heating room and after escaping from it.

The heating room with an area of 14 m² is located in the basement of the house small cylinder. Cold fresh air enters it through two horizontal ducts from the side of the main façade. Three vertical ducts, heating the ground floor of the house and the living room on the first floor, rise from the



Scheme of the existing heating system

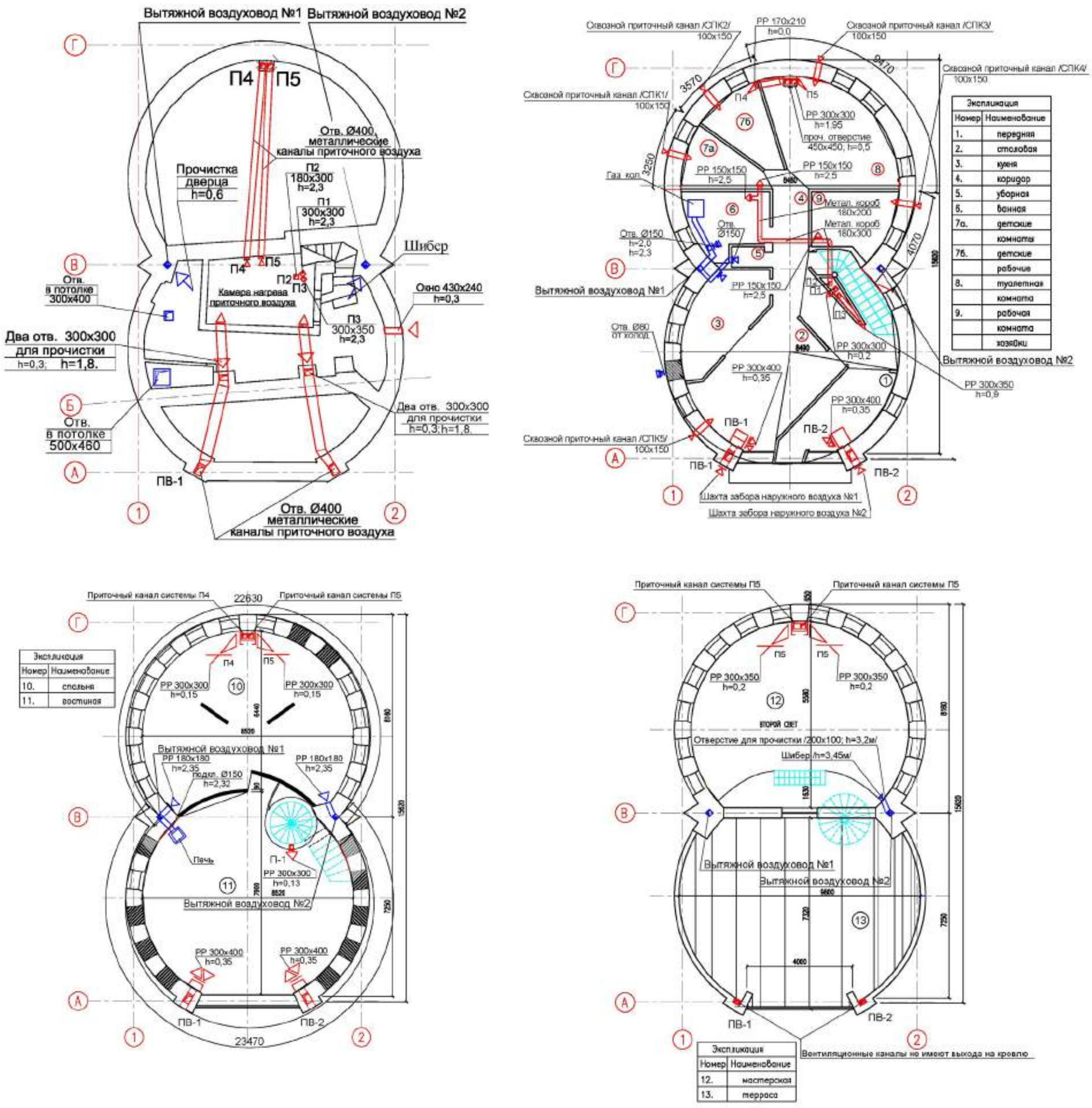


Thermal image of the northeast façade

heating room. Besides heated warm air flows out through two horizontal ducts beneath the floor of the large cylinder. They heat the dressing room (cloakroom) and the daughter's room, and then run to the first and the second floors to warm up the bedroom and the studio.

In 1957 – 1958 hot-water heating replaced stove heating as the house was connected to the central hot-water heating system of Arbat district. Since that time on the heaters consist of steel pipes warmed by hot technical water supplied from the outside. Two apertures were made in the chamber with removable wooden hatches-chokes, which in the open position provide an increased draft of warm air to the rooms on the ground floor (small hatch) and the other floors (large hatch). They have been preserved and function to this day.

According to the results of the recent survey, the power of the heater, existing since the 1950s, is sufficient to maintain the comfort temperature

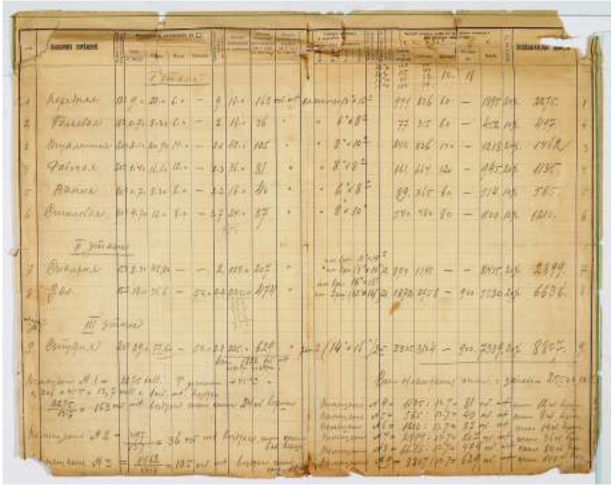


Floor plans with inflow and outflow air heating ducts inside the house during peak cold periods of 25 °C. However, it significantly exceeds the average winter temperatures without any possibility of fine-tuning. The issue of heating is crucial for the long-term preservation of the House and the biggest challenge for further conservation works.

At the moment there are no effective tools to control the temperature and humidity levels in the House during the cold (heating) season, that damages the interiors of the building and its unique memorial content (furniture, paintings, drawings, negatives, books etc.). Also, now it is impossible to heat and to dry the house during a cold rainy summer as the house is fully dependent on the inflexible and energy ineffective heating system controlled by city authorities. There is no option at the moment to change source of heating back to the independent stove heating that allows to 'fine tune' the climate inside the house all around the year.

Measurements of hot air speed and temperature at vents have been made to estimate air flows for various external temperatures from -9°C to +6°C. Effect of air recirculation was estimated as 80/20 (volume of recirculated air inflow / volume outside air inflow).

Archival materials by Konstantin Melnikov have been surveyed. His simple heat model of the



K. Melnikov. Calculation of air-heating (circulating) system. 1928

house contains a number of variables: external air temperature, target temperatures in particular rooms of the house, coefficients of air exchange, size of vents inside the house, speed and temperature of hot air at vents etc.

Thermal characteristics and heat losses via external walls, windows, doors and roof have been measured with sensors and thermal cameras.

In order to build a model of air-heating balance of the house, calculation of maximal capacities of the existing heater has been made (34400 Wh) (in comparison with estimated maximal heat loss of 32800 Wh for extreme outside temperature of

Measuring of thermal properties of the walls and windows

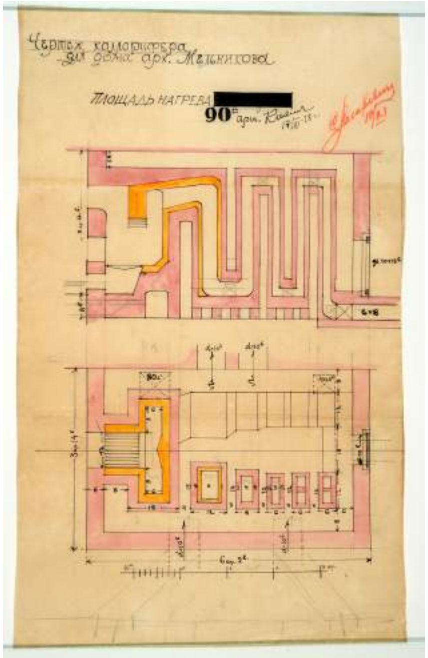
-25°C). The results are also comparable with Melnikov's own calculations of the heater 25500 cal (29700 Wh) made for outside temperature of -10°C.

Calculations of the building heat balance based on the field measurements of heat losses, speeds and temperatures of incoming and outgoing air flows, heat transfer coefficients in separate rooms and other parameters did not reveal any defects and significant deviations from the house thermal characteristics calculated by K. Melnikov in 1928 – 1929.

To control the temperature inside the house, an installation of a heat exchanger at the entry point of the central heating pipes to the building has been proposed with detailed technical recommendations.

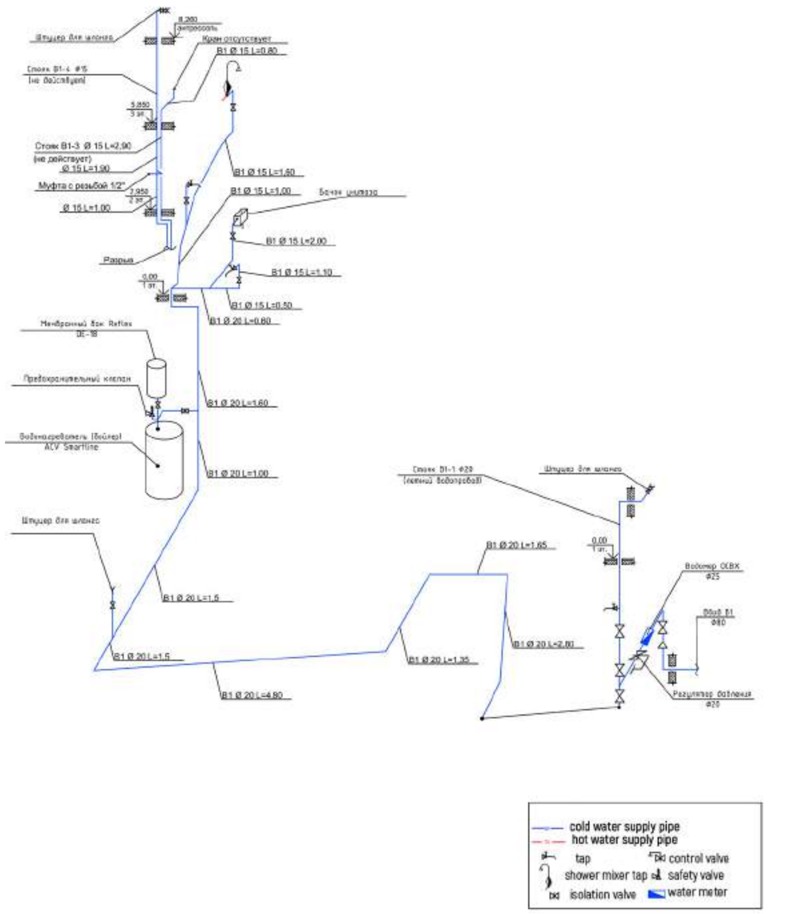
Instead of the currently used by the Museum (as a temporary solution) mobile humidifiers during the heating season, it is proposed to humidify the inflow air directly at the heat source, that is, in the heater room in the basement. The proposed device is an open tank with an evaporation surface area of 2,25 m². Water vapor mixes with the heated air and through five original air heating channels enters all three floors of the house. Water supply to the tank at the required level is controlled by means of a locking mechanism – a float. This simple (and, if necessary, reversible) solution is fully consistent with the low-tech ideas that underlie the whole project of the house. It will provide a smooth alteration of air parameters inside the house in the allowable range during the change of the cold season to the warm and vice versa.

A survey of the technical condition of the heating air ducts was also conducted and photo evidence of their defects and damage was obtained. Partial restoration and subsequent regular maintenance (cleaning, repairing) of the original inflow and outflow air ducts are required.



K. Melnikov. Drawing of the original heater (stove). 1928

Utility networks



Piping isometric drawing of cold water supply

Cold and hot water supply systems, sewerage and drainage, telephone and alert system were surveyed. Water supply and sewer system has not changed fundamentally since 1920s which is evident from surveyed archival documents. All systems were tested and levels of wear and tear estimated. All systems are in satisfactory condition. Detailed recommendations for fragmentary repair and preventive measures were given.

Water supply system

The system of cold water supply is a dead-end, it has not changed since 1929, with the exception of two vertical runs of pipes supplying the studio on the second floor, which have not been used for decades

Original porcelain handles and separate brass sink faucets. Bathroom. Ground floor

Fragments of non-functioning cold water pipes going into the studio on the second floor. Bathroom. Ground floor.

Exit point of the emergency water supply near the stove in the wall of the living-room. 1st floor

According to the results of the survey, floor plans and piping isometric drawings of cold and hot water supply were compiled. Cold water supply includes:

- point of entry from the city network to the basement,
- water meter,
- plumbing system of the building,
- risers and sanitary fixtures supply lines,
- taps, mixer taps, isolation and flow control valves

In addition to the water supply pipes inside the building, a so-called 'summer water supply pipe' (exterior spigot) was designed by Melnikov for gardening, it played an important role throughout the life of the house. This is the 'appendix' of the main pipe in the basement, it passes through the exterior wall.

By request of the Museum, a possibility to use water supply pipes to provide tap water to the studio on the top level (not in use now) was checked by air pressure. Nevertheless, it is not recommended to use the existing original pipes (1929), built inside the walls, as they are not exploited for many decades and are obsolete and rusty.

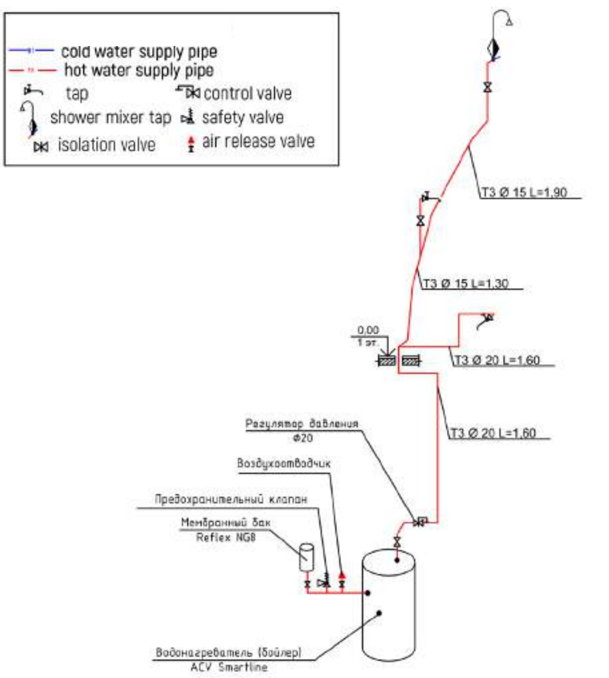
It was also found out that one of the two vertical risers has a horizontal branch (a copper pipe) 15 mm in diameter. It goes through the wall in the bedroom toward the stove in the living room on the first floor. Presumably this is the part of the standpipe (not in use now) built inside the interior wall. It was discovered as a historical evidence of the Second World War period (1944), when Melnikov designed and built a local heater ('suprematist stove') in the living room.

Two separate water supply pipes were intentionally led into the studio of the painter and architect K. Melnikov: one to the sink in the studio for washing brushes and cleaning, the other to the mezzanine so that it was convenient to fill a *'samovar'* for tea parties on the terrace and maintain the terrace itself.

Hot water supply system

Hot water supply system is autonomous and not connected to the city water supply networks. It is provided only on the ground floor of the building – in the kitchen and bathroom. From 1929 to 2013 water was warmed up using a gas water heater in the bathroom. Nowadays water is heated up right in the basement using an indirect electric water heater, while the gas supply to the house is turned off, the gas water heater is a fake.

In general pipes and plumbing fixtures of cold and hot water supply are in operational con-dition. The estimated physical deterioration is 30% for hot and 40% for cold water supply systems. Cold water supply pipes between the ground and the second floors are non-functioning as a result of corrosion, and they are not in use for a few decades. Recommendations are given in the 'Conclusions and Recommendations' section of this report.



Piping isometric drawing of hot water supply

Sewer system

The internal sewer network is made of cast iron pipes and has not changed since 1929. The sewer vent pipe is a continuation of the drain pipe and passes through the attic to the roof. The drain pipe is connected to a gravity sewer located on the east side of the building, using a horizontal run of cast iron pipes that openly pass along the basement floor and the heater room. The existing and functioning sewer well in the courtyard is closed by a manhole cover with the date on it: "1925".

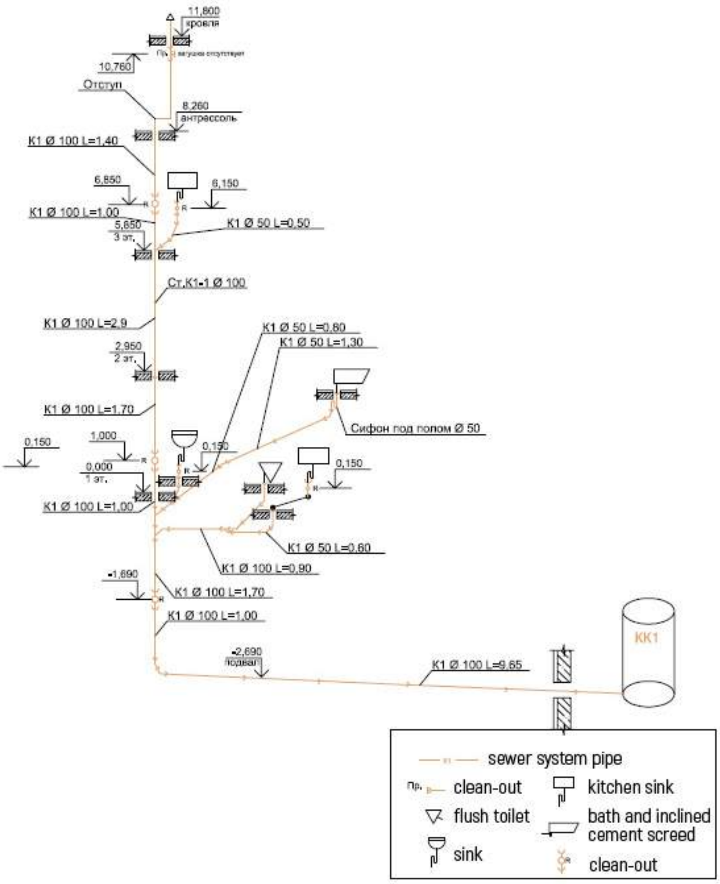
Calculated sewerage physical deterioration is 75%, according to the modern technical regulations, its replacement is required. However, taking into account that the sewer system is actually not in operation – it is used minimally for domestic purposes – it is possible to partially repair it or replace separate parts when necessary.

There are original elements in the kitchen, the toilet and the bathroom: sinks, a bath, a faience

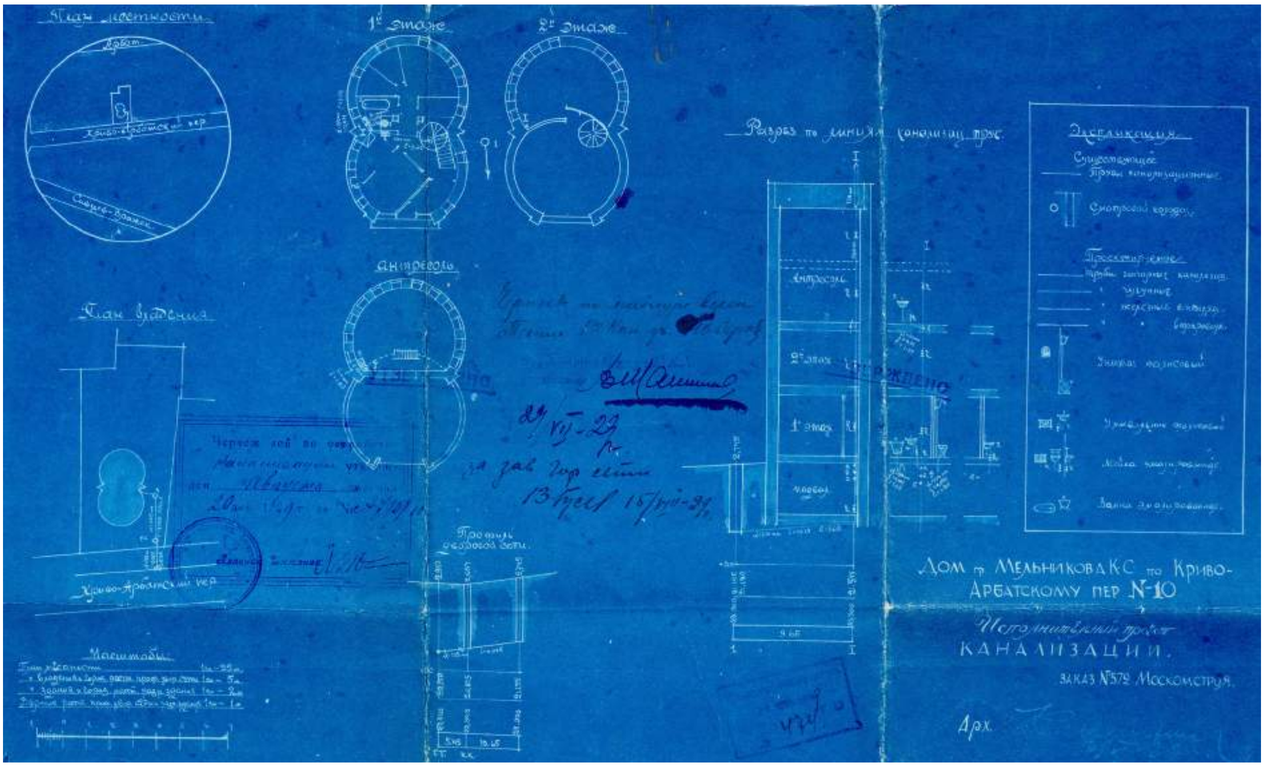
Manhole cover. 1925

Sewer well on the east of the house. 1927

Iron cast trap with a visible disconnect. Studio. 2nd floor



Piping isometric drawing of the sewer system



Executive project for sewage at the house. Blueprint. 1929

flush toilet and a cast iron cistern, which were conserved and installed in their places in 1996. They are a part of memorial content of the house. The sink in the bathroom was replaced with a faience copy of the original (broken) one in 1996.

There is a visible disconnect between an iron cast trap and a drain line under the sink on the second floor. It is necessary to restore this part of sewer system in case of restoration of wa-ter supply system on the second floor.

Drainage system

The drainage (drainpipe) system of the building is an exterior (opened) one.

The water discharge system of the small cylinder roof consists of gutters, which are on metal sloped roof sheeting, and two exterior gutters on the west and east façades of the cylinder, slightly inclined toward two vertical downspouts at the interlock of two cylinders.

From the canopy of the large cylinder water is discharged through two holes on the edges of the roof. After that, water is channeled into inclined hanging gutters and then into the leader heads of the downspouts.

Water is drained from the roof of the large cylinder into the north downspout owing to the slope of the roof of 13°. From the downspout extension water is channeled on the gravel path.

The drainpipe system is in operational condition. Its physical deterioration is 40%. Additional preventive measure is to install a drainage system that will allow channel water away from the site of the Melnikov House.

Sloped metal roof sheeting. Small cylinder

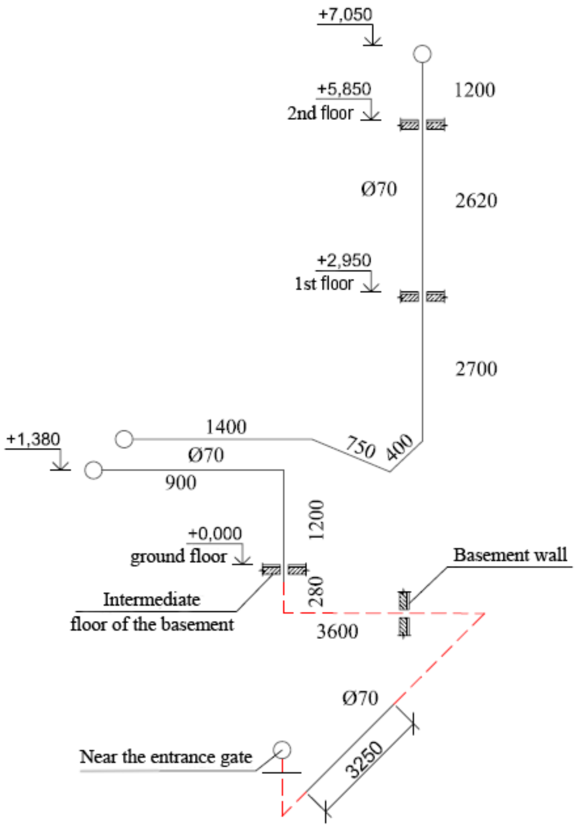
Acoustic string telephone ('Air phone')

Non-conventional engineering system used by K. Melnikov such as "air phone" (a low-tech predecessor of intercom) was tested, described and its current condition was checked. The acoustic telephone designed by K. Melnikov consists of two independent pipes:

1) the line between the gate of the street fence and the corridor of the ground floor (mainly runs underground) has not functioned for decades, it also has disconnects in the basement and underground. A 5 meters long fragment of unused line of the 'air phone', going underground from the house to the entrance gate, was found during special excavation works in spring 2018.

2) the line, connecting the ground and the second floors, is in working condition and allows to transmit human speech. It is also currently used as a conduit for security alarm wires.

There is technical ability to restore the entire original acoustic phone system.



Isometric drawing of acoustic string phone

Excavated underground part of the 'air phone' going from the fence to the house

Exit points of the 'air phone'. Ground floor

Exit point of the 'air phone'. Studio. Second floor

Pipes of the 'air phone'. Closet under the staircase. Ground floor

Security alarm

There is a 24-hour security post outside the building and a video surveillance system around the perimeter, and an "emergency button" at the security post with the ability to call the response team.

Security alarm elements (magnetic sensors on the front door and the terrace door, and electronic motion detectors) are on all floors. There is a control panel with an uninterruptible power supply unit in the building. There is a light and sound alarm notification appliance outside the front door.

The security alarm system outside and inside the house is in working condition.

Telephone

Land telephone cables enter the house on east wall of basement since 1929, run inside the ground floor of the building and are in working condition. No additional work is required. The telephone service available from 1929 to 2014 is currently disconnected.

Fire alarm

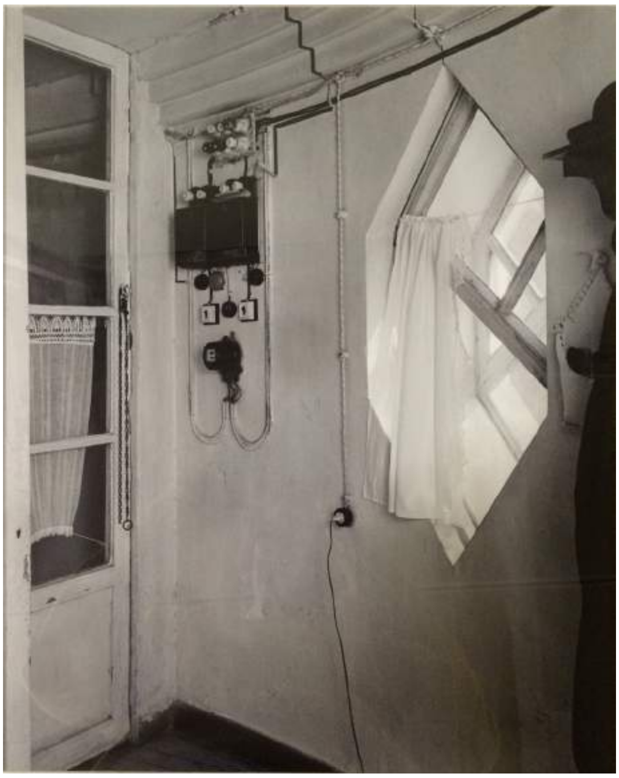
Fire alarm, sound and light warning system, evacuation control in case of emergency are absent. There is no system for automatically transmitting a signal about a fire to emergency services. It should be noted that there is a 24-hour security post outside the building and a video surveillance system. A fire alarm system should be established as part of the conservation project.

Electrical Installations and Wiring

Because of priority and importance of electric systems in terms of light and risk of fire, survey of electric wires and installations, sockets and bulb holders have been done as a separate research by specialized electric laboratory WAYB Group of Companies. Schemes of electric wires and installations by floors were prepared, and detailed recommendations for repair and conservation, regarding each element of electric system, were given in November 2017. Follow-ing the recommendations, implementation works on repair of electrical system have been done in June – September 2018 from non-grant sources. Two original electric lamps have been conserved (simple table lamp in the living room and the covered ceiling lamp in the studio, matt glass, similar to Siemens Luzette model).

The house has been connected to the city electric network since its construction in 1929. Since then, the wiring diagram and equipment have not fundamentally changed, with the excep-tion of the transfer of the main distribution board from the lobby to the basement in the 1990s. Currently, power producer Mosenergo supplies the house with electricity with a maximum simultaneous power of 15 kW. Until the middle of 1960s, the power supply was 110V, later it was changed to 220V.

Today the only power equipment is the boiler in the basement. The house outlets are used to connect security alarm systems, wi-fi and, in the heating season, museum humidifiers. The main consumers of electricity are lamps inside and outside the building. 23 lamps in the house are memorial



Distribution board in the lobby. 1980s

Lamp of 1920s with load and block system. Utility room. Ground floor

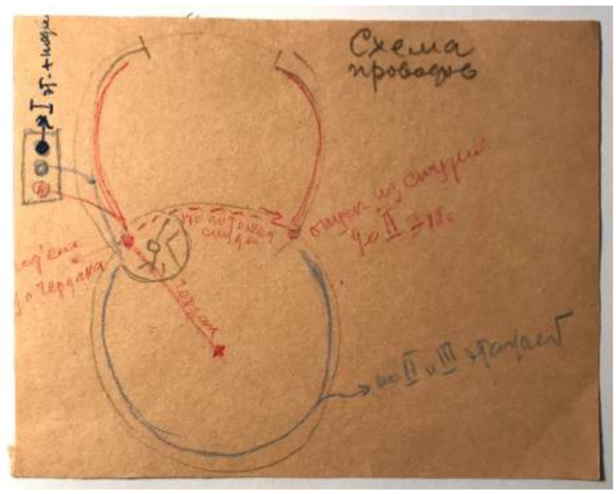
Ceiling lamp of the 1920s of Peter Behrens style after restoration. Studio, 2nd floor

Street number of 1929 with a bulb inside

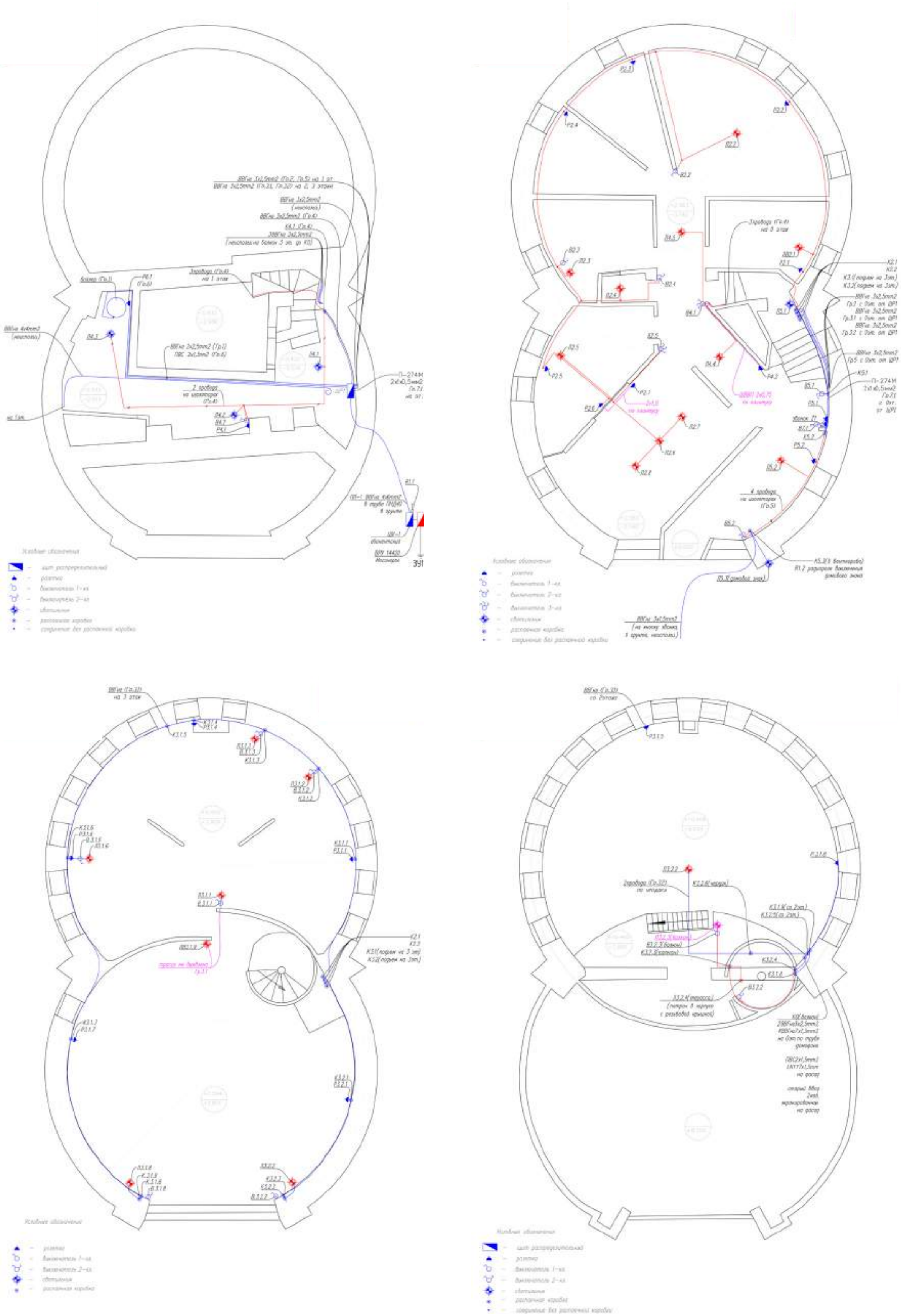
objects of the 1920s – 1930s, they require regular examination and conservation, the program of which is already being implemented by the museum. At the same time, they are used for their intended purpose as illuminators. The original light of the house number is an example of an outdoor electric memorial item.

The electrical wiring was originally designed interchangeable, which for the 1920s was a progressive engineering solution. To this end, pipes and boxes were laid inside the walls of the 1st and 2nd floors, which subsequently allowed renew the wires. The wiring of the ground floor, mezzanine of the 2nd floor and the basement is open (external) on porcelain insulators. It retained its original appearance, but the very wires were replaced during the restoration of the 1990s. Laboratory tests in 2018 showed good preservation of wire insulation and high resistance, which confirms the possibility of safe use of the network if to follow a number of recommendations.

Laboratory tests of electrical equipment were also carried out, a technical report was compiled with recommendations for its safe use, including regular monitoring of its condition. Elements of electrical equipment were examined and tested – a total of 105 items (sockets, bulb holders, junction boxes, etc.). For some of them, repair is recommended, as well as an increase in the area of the ground electrode to achieve a resistance of no more than 4 ohms. Repair works were conducted in 2018 – 2019.



Sketch of electrical wiring. K. Melnikov. 1960s



Electrical wiring and installations. Floor plans

Address

119019 Russia Moscow, 10 Krivoarbatsky Lane

Monument protection category and official title

Object of cultural heritage of federal significance 'Experimental house, 1927 – 1929, by architect K.S. Melnikov' (The Melnikov House)

Architect

Konstantin Melnikov

Building company

«Moskomstroy» Trust – the construction office of the Moscow Communal Services (MCS)

With the active participation of the author of the project and his family

Dates of construction

1927 – 1929, major conservation works in 1989 – 1997

Ownership and current status

State (Russian Federation) State Museum of Konstantin and Viktor Melnikov

Date of survey

Oct 2017 - June 2019

Type of construction

Massive exterior brick walls transfer the load from the wooden intermediate floors (reinforced concrete in the basement) and roof coverings to rubble strips of the foundations.
Inside the building there are brick posts at the level of the ground floor, based on old brick walls, and supporting (formerly unloading) wooden partitions that transfer loads on their reinforced concrete strip foundations, arranged during the restoration of the 1990s, and on the intermediate floor of the basement.

Number of floors

3 floors with a basement under part of the building.

Technical condition according to the survey results

The building is in a limited working condition (judging by the state of the most critical wooden structures of the bearing partitions, floors and coatings) with the presence of dangerous areas: plaster layers of the small cylinder and the large window of the south façade.

Conclusions and recommendations

1. In the process of building the house, K. Melnikov was in active creative search, considering both, the architectural and the constructive solutions. At the same time had to compromise among his artistic conception, technological capabilities (low quality of material and labor) and his own modest financial capabilities. During the construction K. Melnikov repeatedly corrected his decisions «on site». Sometimes the "artist" defeated the "designer" – for example, leaving the exterior walls without protection of window drip caps and the terrace parapet without any protection from precipitation. Difficulties with the financing of the work caused a serious delay in the construction, which in its turn created preconditions for some problems that exist nowadays. Thus, it is possible to point out the preconditions for the occurrence of defects and deformations of the house structures, which lie in his history (imperfect technology, materials, workers' qualifications, constructive solutions, owing to lack of funds), and register their regular occurrence and development over time. The continuity of deformations can be indicated – cracks appear after repairs in the same places throughout the history of the.

2. During the II World War, new problems arose in the house, related to the affection of the temperature and humidity conditions of the house, the physical deterioration accelerated. The house was repaired, subjected to transformations. In the late 1950s the owners of the house lost the ability to regulate temperature and humidity conditions off the heating season, as a result of the reconstruction of the heating system. Later, without own funds for repairs, Konstantin Melnikov, and later his son Victor Melnikov, compromised and agreed to change the roof and then repair the façades of the building.

3. From 1982 the period of restoration of the house began, which, solving old problems, laid the foundation for some new ones. The restoration turned out to be protracted, in the late 1990s and early 2000s, fulfilment of unfinished works still continued: the

blind area, the grading, and utility networks were not completed. New defects in the finishing layers inside and outside the building began to occur. It should be noted that all protective coatings of the wooden structures, applied in the restoration period, at the present time can be considered worn out and require renewal.

4. In the 1990s the adjacent territory began to develop (superstructures or construction after the complete demolition of old buildings – moreover, all of them with deep underground parts) and the question of the related geological risks came to the fore. Now the site of the Melnikov House is densely surrounded by new buildings with underground parking garages. Surrounding buildings worsened the insolation conditions of the house (besides, the comfort of staying at the house, it affects the temperature and humidity conditions of the walls and the site – it indicates that the preconditions for the increase of humidity have been set).

5. The observations of the settlements of the building began in the 1990s. According to the results of the geodetic monitoring analysis, the period of the most intensive impacts from 1994 to 1999 was not monitored at all, and in the period from 1999 to 2006 deformations developed in the first few years (settlements were uneven and reached 5.7 mm in places), and then faded away. Following periods of observation registered the fading nature of the deformations, the latest observations indicate stabilization of the settlements nowadays.

6. According to the results of the defect detection, there are only few cracks in the building that can be attributed to settlement cracks – in the west façade of the small and the large cylinders. The most pronounced defects (cracks in partitions and ceilings) are associated with the insufficient rigidity of the wooden floors and settlements of the load-bearing partitions of the ground floor, set on foundations, which in their turn were built in the 1990s. Nowadays some cracks are even less opened than in 2013, which can be explained by local repairs and measurement errors.

7. According to the results of thermal imaging, the finishing layers and structures undergo significant temperature drops near the heat channels and cold hexagonal apertures, the lower part of the brick walls and the walls near the heat channels are overheated. There are differences in the thermal conductivity of the filled hexagonal apertures and the masonry of walls. Lowering of the thermal resistance of the coatings along the perimeter of the ceilings is detected.

Summarizing the given information, two conclusions can be made:

- cracks in the finishing layers outside the building will inevitably appear;
- cracks in the finishing layers inside the building will inevitably occur too because of the features

(created both initially and during restoration and operation) of the finishing layers and structures.

A universal solution to these problems without significant losses of original materials and even without interference in the author's design is impossible. **Provided with proper operating conditions, monitoring and timely repairs, the building can be considered suitable for use as a museum and the organization of visits with restrictions on the number and total weight of visitors.**

In the period of the upcoming restoration (conservation) works, efforts should be focused on eliminating physical deterioration and certain defects, strengthening the finishing layers, taking into account the identified features of the building. One of the most important things is acting in compliance with the standards of temperature and humidity conditions, which is currently difficult to ensure. It is recommended to provide the Museum with tools for temperature and humidity control, separately from the central heating.

Recommendations for operation, repair and conservation plan

High-risk factors

The most serious threat is now posed by the following:

· Falling of the plaster layers off the façade. The weak areas are the following: the cornice part of the north façade wall and the brick wall of the terrace.

· Further deformation of the large window of the south façade with pressing out of the rotten support beam of the lower frame. It can result in damage and loss of external glazing.

Falling off of the ceiling plaster layers inside the building is potentially dangerous as well. There are also cracks and weakening of adhesion, especially near the staircase and the already collapsed part of the ceiling on the ground floor. There is a small probability of falling off small pieces of plaster and peeling off. There are no preconditions for the collapse of a significant part of plaster without increasing of loads and sudden fluctuations in temperature and humidity.

Measures of accident and irreversible damage prevention

· Remove loose layers of finish (threatening to fall) from the building façade. Temporary protect masonry walls with repair plaster compound.

· Remove the temporary supporting reinforcement board under the lower part of the large window frame, set in 2015. Install a similar board with a section thickness of at least 70 mm, which should be fixed through pre-drilled holes to the intermediate floor structures with minimal dynamic effects. It should be installed a little lower than the existing one. The joint between the board and the bottom of the window frame should be carefully sealed with a slope for precipitation drainage.

· Prevent the collapse of the finishing layers inside the building is recommended to carry out by the following measures: employees and visitors must observe the rules (it is forbidden to run, jump, physically impact on the furnishings and finish, it is forbidden to be under the intermediate floor, where an excursion passes), carrying out visual inspections and tapping the weakest points.

· It should be noted that the museum staff already monitors the state of the finishing layers, records its changes. These are important factors of the safe operation of the building and that's why the monitoring is already carried out by the management of the museum at present.

Recommendations for conservation plan

Foundations and soil under the footing

· Excavation works (such as wells, pits, etc.) should be minimized both in the area and under the building.

· Continue geodetic monitoring of the building, reducing the number of observation cycles per year, however, adding the monitoring program of internal structures (install survey markers on the individual partitions of the ground floor near the maximum deformations and on the ceilings – near the most obvious deflections). Develop a program to monitor cracks in the building, install markers the cracks. Choose the type of survey markers, allowing minimizing the impact on the finishing layers, but at the same time reliably reflecting the deformation of structures.

· Increase the reliability of the building drainage with the help of a new blind area. Partially remove the existing clay screen, leaving a section (and compact the soil under it) 0.5 – 0.8 m wide from the building. Make a new blind area, which allows removing moisture from the soil under it, for example, an intermittent stepped clay blind area. The upper layer is 0.5 m wide and lies above the underlying layer (with a break), which starts at 0.3 m from the building and has the same width as the upper layer. The number of steps of the blind area is from 2 to 3. Local filled-up soil should be used to fill the space under the blind area, while sand should be used for the area near it. There is also another option: the width of the clay screen might be simply reduced to 0.8 m. For walkways around the perimeter of the building well-permeable soils should be used.

- Repair the gutters around the perimeter of the building. It is also necessary to consider the option of removing precipitation from the drainage system to a greater distance from the building – for example, set dry wells of a shallow depth, run pipes in a crushed stone cushion from the building to the north part of the site where set a filter well. The second option is to divert water to the nearest lawns along the perimeter of the site fence.
- Interact with the owners of neighboring sites to prevent the discharge of precipitation from their territory to the site of the Melnikov House.
- Remove large trees in the vicinity of the House, which root systems could potentially affect its foundations.

Exterior walls and building support structures

- Complete cleaning of the façades from the paint coats. Removal of repair layers which have no value and differ from the original lime plaster in composition. Patching up cracks with repair compound. Tapping and complete cleaning of the façades from the detached plaster, or partial strengthening of the plaster layers with injection. It is necessary to develop optimal plaster repair compounds, taking into account the peculiarities of the foundation, the finishing layers of the terrace parapet and the surface of the walls in general. The composition of the plaster must comply with the results of the physical and chemical analysis and 'sand curve' of the original plaster. It is recommended to consider the possibility of using the mesh when plastering critical areas. In the area of wooden shields, the plastering layers should be reinforced as much as possible (with anchors, injection, application of the mesh).
- Repair (partially replace) the unfrozen upper row of bricks of the north wall of the large cylinder and the terrace parapet. These works should be combined with the repair of the large cylinder roof.
- Repair of the plaster under metal windowsills, bringing them into a similar look – making their projection from the wall equal (as much as possible). At this stage it is recommended to work on the optimal shape of drip caps.
- Remove debris and dust from the cracks, which were revealed in the places with cleaned away finishing layers, and reaching the brickwork (including the through-wall crack above the upper window of the northwest façade). Their appearance can be prevented by inserting spiral anchors into the brickwork joints (a horizontal hole is drilled in a joint and a metal anchor with a repair compound is inserted there).
- Remove the old paint and new painting from the window frames (with partial repairs). Repairing window putty, strengthening joints. Partial repair of window glazing.
- Overhaul the large window on the first floor of the south façade with partial repair of rotten parts.
- Provide proper temperature and humidity conditions in the rooms, additional thermal insulation of heating system.
- Clean surfaces of the basement walls from weak elements, application of specialized compounds to places with efflorescence.
- Conservation and repair of the interior of the building. Patch of cracks in walls, partitions and in the places of junction with more rigid structures. A reasonable option is to focus on strengthening the finishing layers and monitoring the occurrence of defects for timely repairs (which was possible during the operation of the building by Melnikov and his family).
- As monitoring measures, one should install additional modern survey markers on walls and partitions.

The intermediate floors of the basement and of the ground level

- Clean exposed metal structures (joists and reinforcing bars) from corrosion products and old protective layers. Provide them with anti-corrosion treatment.
- Sealing chinks and blisters in junctions of concrete and metal beams.

• Conservation of the wooden box of the channel for household waste from the kitchen to the basement.

• Remove floor in the bathroom, replace the joists and lay the floor again. As the bathroom is not used as intended, it will be permissible to leave inclined concrete base under the floors without a drain, otherwise ensure that the collected water is drained to the sewer, or at least to the ground (make a hole for the planned shower gully).

• Install ventilation grilles in the floors of the ground floor.

• Perform minor repair of floors (flattening baseboards, repairing tongue and groove boards, repairing paint coats).

• Repair the ceiling in the heating room. Consider the possibility of its insulation to reduce the heating of both reinforced concrete intermediate floor and stairs to the basement.

The intermediate floor of the ground level

• Increase the resistance of the finishing layers to the movements of structures under load (sagging ceilings, partitions). In the process of the restoration of the 1990s separate large pieces of plaster were fastened with screws on adhesives, bonding agents were applied under pressure into the voids (where plaster sounded hollow), and cracks were patched with spackle and mesh. Now similar measures are recommended, but with application of more modern agents – tapping of the entire plaster layer, strengthening of loose points, application of the mesh to the entire surface of the ceiling. Additionally, to ensure the safety it is necessary to set an obligatory rule – when there is anyone on the 1st floor (staff or visitors), nobody must stay on the ground floor.

• In the living room of the small cylinder it is recommended to perform a selective repair of the floors.

Special measures to take regarding the intermediate floor of the ground level of the large cylinder (former dressing room)

• Transfer the intermediate floor load to temporary supports (in order to unload, including the intermediate floor of the first level), remove floorboards and carry out 100% inspection of the intermediate floor state. Special attention should be paid to the control of the grid support area – to use feeler gauge and conduct mycological research in the most dangerous places.

• Remove those areas of structures that are damaged by rot.

• Apply bio and fire composites to structures.

• Reinforce the edges of the grid damaged by cracks – the easiest way joist sistering.

• Strengthen the joints with wedges.

• Strengthen the floors with additional battens under weak / unsteady places.

• Reinstall the flooring, repair the lower part of the walls (as they are going to be damaged when disassembling the floor). Selectively replace the boards, repair the flooring.

• Alternatively, fixing the deflection of floors installing leveling strips on the grid of floor joists can be considered.

The intermediate floor of the first level

• Increase the resistance of the finishing layers to the movements of structures under load (ceiling deflection, partitions). In the process of the restoration of the 1990s, separate large pieces of plaster were fastened with screws on adhesives, bonding agents were applied under pressure into the voids (where plaster sounded hollow), and cracks were patched with spackle and mesh. Now similar measures are recommended, but with application of more modern agents – tapping of the entire plaster layer, strengthening of loose points, application of the mesh to the entire surface of the ceiling. Additionally, to ensure the safety, it is necessary to set an obligatory rule – when there is anyone in the studio (staff or visitors), nobody must stay in the bedroom and in the living room, which are under the intermediate floor of the first level.

• Perform selective repair of the studio floors – reinforce areas with damaged tongue-and-groove joints, weak and unsteady areas of the floor. It is recommended to minimize the opening of the floors, the dynamic effect on them.

• Special monitoring of the intermediate floor state is necessary – in case of negative dynamics, indicating damage to the supports of the intermediate floor by rot (increase of deflections in these places, increase of cracks, plaster detachment), measures, explained for the intermediate floor of the ground level (under the bedroom), will be necessary for the intermediate floor of the 1st level. Up to that moment, interference should be minimized, assuming that the possibility of worsening of the intermediate floor state with arranged proper operation is minimal.

The roof of the large cylinder

• To ensure safety of the ceilings and partitions under the bent structures, especially due to dynamic effects. It is recommended to increase the resistance of the finishing layers to such dynamic effects. In the process of the restoration of the 1990s, separate large pieces of plaster were fastened with screws on adhesives, bonding agents were applied under pressure into the voids (where plaster sounded hollow), and cracks were patched with spackle and mesh. Now similar measures are recommended, but with application of more modern agents – tapping of the entire plaster layer, strengthening of loose points, application of the mesh to the entire surface of the ceiling. Additionally, to ensure the safety, it is necessary to set an obligatory rule – when there is anyone in the studio (staff or visitors), it is prohibited to carry out any works on the roof of the large cylinder.

• An important task is to exclude even the potentiality of the roof leaks. In order to do this, it is necessary to dismantle the standing seam panels of the roof circle near the northern downspout (almost the entire area behind the northern support beam), fix sags of the spaced sheathing and adjust the required slopes of the roof, assemble standing seam panels of a larger size (to reduce the number of connections). Simultaneously with these works, having accessed the under-roof space behind the northern beam, it is necessary to examine the state of the structures (currently inaccessible for inspection), install the missing vent in the northeast wall of the large cylinder, repair masonry of the walls (damaged by defrosting), remove excess waterproofing from the end surfaces of joists, level and clean loose-fill insulation, apply bio and fire protection to wooden structures, reinforce the rest point of the northern beam near the through-wall crack.

• Carry out local repairs of the roofing, paint the roof and apply sealant to all joints. Seal the junction of the roof and the vertical structures.

• Remove excess waterproofing from the end surfaces of the ceiling joists in order to let moisture out of wood.

• Clean the attic from debris, clean loose-fill insulation from dirt, level it (add thermal insulation if necessary).

• Refresh bio-and flame protective coatings of the wooden parts of the roof.

• Protect vents from penetration of birds.

• Sand the metal rods of the roof vertical projection and paint them again, repair the places of their embedment in the wall masonry.

The roof of the small cylinder

• The most important is to ensure safety of the ceilings and partitions under the bent structures, in particular due to dynamic effects. Increase the resistance of the finishing layers to such dynamic effects. In the process of the restoration of the 1990s, separate large pieces of plaster were fastened with screws on adhesives, bonding agents were applied under pressure into the voids (where plaster sounded hollow), and cracks were patched with spackle and mesh. Now similar measures are recommended, but with application of more modern agents – tapping of the entire plaster layer, strengthening of loose points, application of the mesh to the entire surface of the ceiling. Additionally, to ensure the safety, it is necessary to set an obligatory rule – when there is anyone in the living room (staff or visitors), access to the terrace, carrying out there any works is prohibited.

• Choose an elastic (flexible) compound to fill plaster cracks of the façade inscription and cracks at the junction of the inscription with the walls, identical in color and texture to the one of the façade inscription. Clean cracks and fill with the repair compound.

· Protect vents and holes for the gutter in the terrace parapet of the small cylinder against birds, and also remove all debris, apply fire retardants and bioprotective compounds to accessible wooden structures.

· Sand and repaint the metal parts of the parapet, repair the places of their embedment in the wall masonry, conserve the wooden filling in the center.

· Replace the entire wooden deck. The entire deck should be divided into easily removable shields in accordance with the original design and material by K. Melnikov. For this it is possible to use the restoration project of the wooden deck of the 1990s.

· Rinse the surface of the roof until complete removal of dirt. Solder again the joints of roofing sheets with leader heads, repaint the roof. Apply sealant to all sheet-metal seams, joints and joins.

· Remove the gutters, check them for corrosion, add new elbows or replace them entirely. Clean fastenings of downpipes from old coverings, to prime and paint in two times. Restore the rainwater downpipe system and adjust the slopes.

Additionally, it should be noted that to the guidelines for the house operation the following obligatory actions must be introduced:

· during the cold season – after each snowfall: clean the roof of the large cylinder and roof overhang from snow; clean the terrace of the small cylinder, the parapet, the gutters from snow;

· during the warm season – regularly inspect the drainage system and the surface of the roof, including under the deck of the terrace, and, if necessary, clean the roof and the drainage system from leaves and debris;

· seasonal works during the change of periods (summer – winter) – raise the terrace flooring, wash the roof and the drainage system, inspect joints and seams, remove the old and application of new layers of sealant, inspect vents and the ventilation system;

· during the cold season, pay special attention to the frost formation on the roof and the state of the living room ceiling.

Stairs

· Stairs to the basement: repair the cement coating of steps.

· The main staircase: repair and reinforcement of the finishing layers, by analogy with the living room ceilings (for greater resistance to movements of the wooden elements with insufficient rigidity). It is recommended to reinforce (restore) the steps between the 1st and 2nd floors.

· Mezzanine stairs: repair of the finishing layers.

Since the intensity of the impact on the stairs during the subsequent use of the house as a museum is planned to increase, and the rigidity of the steps and handrails of the stairs is insufficient, their operation requires following certain rules of the load limitation:

· it is unacceptable to use the main staircase, if there are other visitors under the staircase; too heavily rest upon the handrail of the staircase is prohibited;

· a simultaneous movement of not more than 3 people on the main staircase is recommended;

· on the mezzanine stairs the movement of one person is allowable, with that heavily rest upon the handrail is prohibited.

Utility networks

Electrical Installations and Wiring

· In 2017 – 2018, the museum carried out such works as inspection, repair of electrical wiring and electrical appliances and the restoration of original lamps.

· The certified laboratory specialists drawn up electrical equipment diagrams and floor plans, and tested the system.

· The system is in working condition and does not require additional conservation works except for routine maintenance and repair.

Water supply

· Cold water pipelines in the basement and on the ground floor are in working condition. Their calculated physical deterioration is not more than 40%.

· Pipes running to the second floor, as a result of corrosion, are in disrepair and have not been used for several decades. If a decision will be made to restore the water supply to the studio, it is necessary to replace them taking into account 100% wear. However, bearing in mind the hidden running of pipes, the risks, associated with possible damage to the interior decoration, should be taken into account.

· Hot water pipes are in working condition. Their calculated deterioration is not more than 30%.

· Partial replacement of locking devices and separate sections of cold and hot water pipes on the ground floor is required.

· It is recommended to perform thermal insulation of the pipes in the basement.

· It is advisable to connect the boiler to the central heating system and use the heat, entering the building during the heating period, also to heat water in the water supply system.

Sewer system

· In addition to the cast-iron sewer pipes of the 1920s, the sewer system includes numerous original elements (sink, bath, toilet seat, etc.), which are part of the house interiors and the objects of the museum display.

· Calculated sewerage physical deterioration is 75%, according to Russian technical requirements in force, its replacement is required. However, taking into account that the sewer system is actually not in operation – it is used minimally for domestic purposes – it is possible to partially repair it or replace separate parts when necessary.

· Restoration of the vertical sewerage between the ground and 2nd floors depends on the decision to restore water supply in this section.

Drainage system

· The drainage system of the building is open. It is in working condition. Its physical deterioration is not more than 40%.

·Additional preventive measure is to install a land drainage system that will allow channel water away from the site of the Melnikov House.

Acoustic string telephone

· The acoustic telephone designed by K. Melnikov consists of two independent pipes:

· the line between the gate of the street fence and the corridor of the ground floor (mainly runs underground) does not function;

· the line connecting the ground and the second floors is in working condition and allows to transmit human speech. It is also currently used as a conduit for security alarm wires.

· The technical ability to restore the entire original acoustic phone system is available.

Security alarm

· The security alarm system outside and inside the house is in working condition.

· There is a 24-hour security post outside the building and a video surveillance system around the perimeter.

· There is a 'emergency button' at the security post with the ability to call the response team.

Telephone

· Telephone cables run inside the building and are in working condition; no additional work is required.

· The telephone service available from 1929 to 2014 is currently disconnected.

Fire alarm

· Fire alarm, sound and light warning system, evacuation control in case of emergency are absent. There is no system for automatically transmitting a signal about a fire to emergency services.

· It should be noted that there is a 24-hour security post outside the building and a video surveillance system.

· A fire alarm system should be established as part of the conservation project.

Heating systems and ventilation

· Calculations of the building heat balance based on the field measurements of heat losses, speeds and temperatures of incoming and outgoing air flows, heat transfer coefficients in individual rooms and other parameters did not reveal any defects and significant deviations from the house thermal characteristics, calculated by K. Melnikov in 1928 – 1929.

· The power of the heater existing since the 1950s is sufficient to maintain the comfort temperature inside the house during peak cold periods of 25 °C. However, it significantly exceeds the average winter temperatures without any possibility of fine-tuning.

· To control the temperature inside the house, a variant of a heat exchanger at the entry point of the central heating pipes to the building is proposed.

· Instead of the currently used by the Museum (as a temporary solution) mobile humidifiers during the heating season, it is proposed to humidify the inflow air directly at the heat source, that is, in the heater room in the basement. The proposed device is an open tank with an evaporation surface area of 2,25 m2. Water vapor mixes with the heated air and through five original air heating channels enters all three floors of the house. Water supply to the tank at the required level is controlled through a locking mechanism – a float.

· This simple (and, if necessary, reversible) solution is fully consistent with the low-tech ideas that underlie the project of the house.

· Restoration and subsequent regular maintenance (cleaning, maintenance repairs) of the original inflow and outflow air ducts are required.

Mycology

· General condition: the house has local areas of old biodegradation. They require point repair and restoration, as well as bioprotection.

· In the openings traces of vital activity of wood-decay fungi were found in the form of rot, however, viable fungi were not found.

· The plaster layer of the façade has areas of biodeterioration and salt corrosion, requiring biocidal treatment.

· Moreover, areas of salt corrosion were found in the basement, biodeterioration there is moderate.

· The wood of the intermediate floor under the ground floor has local areas of rot with a complete loss of strength, which implies entire or partial replacement of damaged sections of structures. It is recommended to replace the loose-fill sound insulation of the intermediate floor. New, replaced parts and old wooden structures should be treated with a bioprotective agent.

· In the roof structures serious damage with a significant loss of strength (dangerous) was not fixed.

· Preservation of biodeteriorated materials is possible by their conservation using chemical biocides or creating conditions that will prevent the growth of microorganisms. In this regard, it is recommended to establish a constant temperature and humidity regime and provide ventilation.

Colors and paints

· The architectural paint research serves as a basis for two goals:

· To match the quality of the paint layers in color, structure and character

· To support facts and details of the residential history and alterations

· The in-depth analysis of the first 18 samples is just a beginning. It is recommended to continue paints and colors survey by the analysis of all taken 120+ samples.

· A non-destructive approach to inform the public about the original color scheme is suggested. The quality of the original finishes will be explained to visitors by demonstration of the reconstructed paint layers on panels.

Documentary and archival research

· The subject of protection (list of protected features) of the monument must be clarified and supplemented according to the results obtained.

· The research results provide a complete information base for the scientific conservation and reconstruction of historical fruit and vegetable garden as well as small architecture objects in the garden (a shed, a bench, a table, a sport ground etc.)

· Taking into account considered inclusion of the monument on the UNESCO World Heritage List, conservation works play a special role not only in the very building and in the garden, but also in the state of the surrounding area, represented by neighboring buildings (so called 'buffer zone' in UNESCO terminology), remained and lost views from the house and its role in urban environment.

Logic and timing of conservation implementation works

The Melnikov House is generally in satisfactory condition. There is no need in emergency measures with exception to the exterior frame of the large window and some fragments of external plasters. But the house certainly needs a number of the medium-run (3-5 years) local conservation repairs inside and repair of the entire surface (plaster and paints) outside. They were mentioned above.

All the measures, listed above, are only advisory and the decision on their expediency is made by the chief architect-conservator and the authors of the relevant parts of the future conservation project. In specialized reports on the results of the research, alternative options for a stronger interference (e.g. structural reinforcement) are left to the choice of the authors of the conservation project.

Most of recommendations and conservation policy principles which are mentioned above can be summarized as:

- focus on the preservation of material authenticity as well as design authenticity;
- minimal intervention, or no intervention at all, if possible ('less is more');
- regular monitoring of the building (settlements, cracks, climate, fungi, drainage etc.);
- regular maintenance (clearing of the roof after snowfalls, issues of vegetation etc.);
- no need to close the house for visitors (bearing in mind safety rules) as all works will be done step-by-step;
- preparation and enforcement of rules for staff and visitors ('code of conduct') in the house to preserve fragile structures, materials and objects (including limit for number of visitors, number of tour groups per day, total weight of the group etc.)

The main conservation choices are related to issues of renewal (meaning: at least partial replacement) of existing obsolete structures (intermediate floors, wooden shields in hexagonal apertures etc.). As it means immediate loss of authentic materials, the other non-destructive alternatives such as keeping status quo and tolerance to certain defects such as cracks, bearing in mind regular monitoring, should be always considered as priority choice.

Logic and timing of the conservation implementation works now looks as the following:

Year 1

- preparation of detailed conservation implementation plan and related documentation according to the local legislation;
- receiving approvals from regulatory bodies;
- emergency works toward the large window in the living room;
- regular monitoring of the building.

Year 2

Façades and other outside works:

- roof repairs and roof coating, terrace steelsheet works and coatings;
- façade works (lime plaster and lime paint works);
- exterior window frames, closed hexagonal apertures (including issue of hexagonal wooden shields), door works, exterior windowsill works;
- regular monitoring of the building.

Year 3 and Year 4

Interior works (local repairs):

- repair of the intermediate and roof floors;
- strengthening plasters and paints;
- conservation of other internal wooden structures and elements;
- conservation/reconstruction of the historical garden;
- regular monitoring of the building;
- guidebook for further care and maintenance of the house.

Appendices

Chronology of the Melnikov House

20.04.1927 – Architect Konstantin Stepanovich Melnikov is assigned a plot of land at the address 10 Krivoarbatsky Lane, Moscow, for construction of an 'exemplary dwelling'.

20.07.1927 – K. Melnikov is given building permission. The district engineering department approves the original version of the house: with no basement, a stove in the centre of the ground floor, a mezzanine floor for children's rooms above the living room (where the balcony/terrace is located), and with glazed windows on three floors in both cylinder structures.

1927 – Construction of the house is begun in September. By the end of that year the foundations have been built and the outer brick walls erected with a temporary roof.

1928 – Completion of the wall masonry, wooden intermediate floors and sheet iron roofing on the cylinders.

1929 – Final version of the house is approved. The wooden floor of the terrace is laid along the ridge details of the small cylinder roof. Finishing of the façades and interiors is completed. The house is connected to systems providing sewage disposal, water and gas. Ventilation and heating system begins functioning. The house is fenced, with a gated entrance.

August - October 1929 – The Melnikov family of four moves into the house: the architect Konstantin Melnikov, his wife Anna Melnikova and their children Lyudmila (aged 16) and Viktor (aged 14).

November 1929 – The house is approved by a city commission, and the first visitors leave comments in a visitors' book.

1933 – End of the 'Golden Age' of architect K. Melnikov (1923–1933). In the past 10 years 18 projects have been realised: the Makhorka Pavilion, the Lenin Mausoleum, the New Sukharev Market, two exhibition pavilions abroad, six workers' clubs, two garages, etc.

1930–1941 – The external appearance of the house is altered with dismantling of the horizontal drainpipes around the small cylinder that gave insufficient drainage and gutters are installed from openings perpendicular to the wall. Two holes are made in the lower part of pylons on the main façade, to allow air into the heater. A new canopy above the entryway is added above the cast-iron corbels.

1935 – Persecution of K. Melnikov begins, with the appearance of critical articles on him in the Soviet press.

1936 – K. Melnikov is dismissed from the Moscow Architectural Institute.

1936 – K. Melnikov's daughter Lyudmila marries and leaves the house. In 1941 her family moves to Tashkent.

1937 – The work of K. Melnikov is publically censured at the 1st Congress of Soviet Architects.

1938 – K. Melnikov is dismissed from the Mossoviet workshop and suspended from professional activity.

1940 – K. Melnikov's son Viktor marries.

1941 – On 23 July an aerial bomb damages the Vakhtangov Theatre on the Arbat. The force of the explosion smashed the windows of surrounding houses, including Melnikov's house.

1941–1944 – The architect's family spends the winter in their basement, furnished with two beds. In the far end of the basement there is a stove for cooking. All the windows in the house are covered with whatever materials come to hand.

1942 – A small temporary stove is installed in the studio.

1944 – V. Melnikov uses the studio to work on his artist's diploma.

1944 – A temporary stove is set up in the ground floor corridor, and the family moves from the basement to the ground floor of the large cylinder. All the windows remain covered until the end of the war. A stove for heating is designed and installed by K. Melnikov in the living room. This is later replaced by a new stove, which has been preserved. Temporary stoves provide heat on the other floors. The entire house becomes habitable.

1948–1950 – Several partitions and the built-in cupboard on the ground floor of the large cylinder are dismantled. In the bedroom the original bed podiums and the plaster on the floor are removed. Renovation of the wall plaster and ceiling is carried out. Wallpaper is pasted over the walls and white paper on the ceiling. The heater is operational again, initially burning firewood, later coal. Temporary stoves on the ground and 2nd floors are dismantled. In the summer the ground floor of the large cylinder is repaired. Walls and ceilings are treated with a copper sulphate solution and covered with fresh whitewash. In the children's rooms and toilet the ceilings and one wall (the yellow wall) are repainted; new wallpaper is put up in the dining room.

1950 – Viktor Melnikov's wife and his daughters Elena and Ekaterina move into the house. Viktor's family lives in two rooms on the ground floor of the house's large cylinder until the late 1950s.

1949–1951 – K. Melnikov leaves to take up a position teaching at Saratov Automobile and Road Construction Institute, periodically returning to Moscow.

1952 – A separate entrance to the house for V. Melnikov's family is built in the kitchen, replacing the built-in cold-storage cupboard.

1958 – Heating from stove is replaced by hot-water heating. Central hot-water heating radiators are installed in the basement heating chamber and the coal hatch is filled with bricks.

1951–1974 – K. Melnikov teaches at the Moscow Engineering and Construction Institute (MISI) and from 1959 at the All-Union Correspondence Engineering-Construction Institute (VZISI). In 1952 he is awarded the rank of professor.

1961 – Attempt by local authorities to remove K. Melnikov and his family from the house.

1964 – Repair work is carried out on the roof of both cylinders. The covering is made from three layers of tarboard. The sheet iron roof on the small cylinder is partly removed and the triangular gutter ridges dismantled.

1966 – K. Melnikov's daughter Lyudmila and her family return to Moscow after the Tashkent earthquake.

1965–1974 – K. Melnikov is rehabilitated and publicly acknowledged. An exhibition and jubilee evening dedicated to his 75th birthday (in 1965) are held at the Central House of the Architect. He is awarded the honorary degree Doctor of Architecture (1967) and title Honoured Architect of the RSFSR (1972).

28.11.1974 – Death of K. Melnikov.

1976 – Repair of the façades, the window sashes are painted dark brown and the external windowsills a silvery colour. The façades are wiped with a cement solution and painted white. The building acquires a lustre inconsistent with the original concept.

08.08.1977 – Death of A. Melnikova, wife of K. Melnikov.

1980–1988 – 'Spetsproyektrestavratsiya' [Special Project Restoration] Institute devises a project for restoration of the house.

1987 – The house is recognised as an architectural monument 'of regional significance', together with several other Moscow buildings dating from the Soviet period.

1989 – Restoration of the house begins, financed by the sale of catalogues for the German artist Günther Uecker's exhibition in Moscow. Structures erected for restoration are not contiguous to the house, to ensure that no damage occurs. After the roofing and ceiling above the large cylinder have been dismantled work is halted due to insufficient funding.

1990 – The kitchen door is removed and replaced by a built-in cold-storage cupboard in accordance with the original project.

1992–1993 – A. Popov's architectural workshop carries out work to replace the roof structures of the large cylinder and restore the roof of the small cylinder. Due to inadequate funding further work is halted.

1994–2014 – Large-scale commercial buildings around the house interferes with the natural lighting and hydrogeology. The original views from the house are lost.

1996–1997 – Restoration work on the house by the Restoration Experimental Engineering Workshop №5 (headed by M. Kapustina).

07.05.2003 – Death of Lyudmila Melnikova (Ilganayeva), daughter of K. Melnikov and A. Melnikova. Property rights to a half-share of the house are inherited by her son Alexei Ilganayev.

03.08.2005 – V. Melnikov compiles a will by bequeathing his half share of property rights on the house with the monument's historic furnishing and the entire creative archive of K. and V. Melnikov to the Russian Federation, on condition that a state museum is founded to commemorate the Melnikovs, both father and son.

December 2005 – President of the Russian Avant-Garde Foundation S. Gordeyev purchases the share property rights of the house from A. Ilganayev.

05.02.2006 – Death of V. Melnikov.

05.02.2006 – 17.10.2014 – V. Melnikov's daughter Ekaterina Viktorovna Karinskaya takes up residence, declaring herself custodian of the house. She refuses entry to the other daughter, Elena Viktorovna Melnikova. Execution of V. Melnikov's will is delayed for many years.

December 2010 – S. Gordeyev donates his half-share in property rights on the house to the Russian Federation.

June 2011 – Russian Federation allocates the half-share of property rights on the house to the Schusev State Museum of Architecture so that a museum may be established there.

August 2012 – Federal Agency for State Property Management (Rosimushchestvo) draws up a conciliatory agreement between the Russian Federation and the architect's descendants. E. Karinskaya's refusal to sign it prevents implementation.

March – July 2013 – Museum of Architecture holds a competition for the concept of turning the house into a museum.

May 2013 – Museum of Architecture's plea to the Moscow mayor for cessation of building work near the house is supported by more than 10 thousand signatories.

October 2013 – Museum of Architecture signs the preservation obligations for the Melnikov House.

November 2013 – Museum of Architecture conducts a historical and cultural assessment to raise the state protection status of the house.

December 2013 – Plaster patches are applied to interior wall cracks in the house as sensors monitoring structural integrity.

February 2014 – Russian Culture Ministry establishes the State Museum of Konstantin and Viktor Melnikov as a branch of the Museum of Architecture.

March 2014 – Russian Federal Government raises the monument's protection status to the level 'object of cultural heritage of federal significance'.

August 2014 – The Melnikov Museum begins an inventory of the memorial contents of the house.

December 2014 – The Melnikov Museum opens the house on an experimental basis for excursions by visitors.

February 2015 – The Melnikov House joins international Iconic Houses Network.

March 2015 – The Melnikov Museum starts an expert examination of the house, prior to restoration with assistance from the British company Arup.

April 2015 – The Melnikov Museum opens the courtyard of the house as a public space freely accessible to visitors on a daily basis.

September 2015 – The exhibition-installation 'Melnikov Revealed' is unveiled in the courtyard of the house to mark the 125th anniversary of the architect's birth.

May 2015 – September 2016– Landscape gardening works, reconstruction of the garden paths and flower beds

May 2016 – A twinning agreement between Villa Savoye (Poissy, France) by Le Corbusier and Melnikov House is signed.

June 2017 – "Keeping It Modern' Getty Foundation grant award for the pre-conservation research and conservation planning to the Melnikov House.

Dec 2017 – A theatre performance 'Melnikov. Documentary opera', based on recently found in the house Melnikov's diaries, is on stage of the Museum of Architecture.

Sept 2017 – June 2019 – Pre-conservation technical survey of the house and the adjacent site is completed by a team of local and international experts.

April – August 2019 – Reconstruction of the memorial vegetable garden and Melnikov's garden shed in the backyard of the house.

August 2019 – Inventory of the memorial contents of the house is completed by the Melnikov Museum with 27000+ units on the list.

Biographical data of Konstantin Melnikov

Portrait of Konstantin Melnikov. 1930s. Photo: M.S. Nappelbaum

Konstantin Stepanovich Melnikov (3 August 1890 – 28 November 1974)

Russian architect, artist, teacher. A leading figure in avant-garde Soviet architecture of the 1920–1930s. Well known for his designs of workers' clubs, garages and exhibition pavilions. Achieved worldwide fame in 1925 after designing the USSR Pavilion for the International Exposition in Paris. Designed a glass sarcophagus for the body of Lenin (1924). Submitted a number of urbanist projects for Moscow in the early 1930s. From 1938 he was excluded from architectural activities. Between 1965 and 1974 Melnikov was rehabilitated and awarded public recognition.

Designed and constructed, primarily in Moscow:

1923 – Makhorka Pavilion at the All-Union Agricultural and Handicraft Industries Exhibition

1924 – sarcophagus for the body of Lenin

1924–1926 – New Sukharev Market

1925 – USSR Pavilion at the International Exposition in Paris

1926 – USSR Pavilion at the International Fair in Thessaloniki, Greece

1926–1929 – garages: Bakhmetevsky Bus Garage and Novoryazanskaya Street Truck Garage

1927–1929 – his own house on Krivoarbatsky Lane

1927–1930 – workers' clubs: Rusakov, Svoboda, Kauchuk, Burevestnik, Frunze and for Pravda newspaper in Dulevo

1930 – reconstruction of Kamerny Theatre

1934–1936 – Intourist Garage

1936 – Gosplan Garage

Important unrealised projects (competition entries are marked by an asterix):

1923 – complex of model housing for workers in Moscow*

1923 – Moscow branch of Leningradskaya Pravda newspaper*

1923 – Palace of Labour in Moscow*

1924 – Arcos Joint Stock Company building in Moscow*

1925 – taxi garage-rank for the Seine bridges and automobile garage in Paris

1927 – Zuev Club in Moscow*

1929 – Christopher Columbus Monument and Lighthouse in Santo Domingo*

1929 – reconstruction of Gorky Park

1929–1930 – Green City in Moscow Region*

1930–1931 – Frunze Military Academy in Moscow*

1931 – reconstruction of Arbat Square

1931 – MOSPS Theatre in Moscow*

1931–1933 – Palace of Nations in Moscow*

1932–1933 – Palace of Labour in Tashkent

1934 – Narkomtyazhprom building in Moscow*

1936 – housing for Izvestia newspaper workers in Moscow

1936 – USSR Pavilion for the International Exposition in Paris*

1962 – USSR Pavilion for the World Expo in New York City*

1967 – Arbat Street children's cinema in Moscow*

Cultural Heritage Agency
Ministry of Education, Culture and Science

Melnikov House Moscow

Konstantin Melnikov, Moscow, 1929

Analysis of paint layers

Research Report

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Heritage Laboratory

Commissioned by: Schusev State Museum
RCE project: 2019-051
Date: June 2019

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Research report

Melnikov House Moscow

Konstantin Melnikov, Moscow, 1929

Research of Luc Megens and Mariël Polman

Date	:	13 June 2019
Author(s)	:	Megens, Luc and Polman, Mariël
Researchers involved	:	Megens, Luc and Polman, Mariël
RCE project number	:	2019-051

Prepared within the framework of the grant agreement between the Schusev State Museum Architecture and the Getty Foundation #R-ORG-201735134 dated 14 June 2017 for technical survey and preparation of a conservation plan for the Melnikov House (Moscow, Krivoarbatsky per., 10)

Photograph cover page

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Owner / Museum

Museum / Institute	State Museum of Konstantin and Viktor Melnikov

Object / collection

Object type	experimental residential house and studio of the architect K.S. Melnikov ; since February 2014 : the State Museum of Konstantin and Viktor Melnikov as a branch of the Museum of Architecture
Title	Melnikov House
Creator	Konstantin Melnikov (3-8-1890-28-11-1974)
Date of creation	1927-1929
Place of creation	Moscow, Krivoarbatsky per., 10
Location	Moscow, Krivoarbatsky per., 10
Dimensions (HWD in cm)	H 11,80 M
Material / Technique	Paint layers on wood, plaster, metal

Introduction

The Melnikov House

‘The Melnikov House, a building designed by architect Konstantin Melnikov in Moscow for himself and his family is an icon of the architectural avant-garde. The house was originally built as an experimental cylindrical house to test Konstantin Melnikov’s very own concept for the mass construction of housing. The original layout, elegant spatial arrangement and ingenious engineering techniques have made this masterpiece world famous.

According to Melnikov, the essence of his house lies in its ‘equivalence and equability of weight, light, air and heat’. Being of a unique architectural form, it still looks modern while retaining the authentic memorial atmosphere of the 20th century, thus reflecting the tragic life of this solo architect.’ [Lit. 1]

The iconic house is composed of a double cylinder, plastered façade with hexagonal, octagonal and orthogonal windows, a huge window, a front door and a double glass door to the terrace.
The floor plans includes a basement, a first floor with entrance, hallway, corridor, dining room, kitchen, toilet, bathroom, boy’s room, girl’s room, large dressing room (later Viktor Melnikov’s bedroom), room of the lady of the house (later Viktor’s study) and a small closet under the staircase.
The staircase to the basement , the main staircase from the first to the third floor and the stairs to the entresol in the studio.
The second floor with the living room (/studio) and the bedroom (later Anna’s room)
The third floor with the studio and entresol.
The roof terrace.
A fenced garden.

Colour is definitely a mayor quality as well, considering the fact that Konstantin Melnikov was an architect and a painter, and Viktor Melnikov was a painter as well. From the interview of Viktor Melnikov by Oleg Adamov (see Lit. 2) it is clear that Viktor Melnikov is very sensitive for the qualities of colour and light . He remembers well the extraordinary subtle shades of the paint layers and other finishing layers, the colours, the texture, the light and reflection within the rooms and the façade outside. The architectural paint research and reconstruction in the 1990s was executed following the accepted methods. The situation as its stands represents the original colour scheme. It is based on architectural paint research and contemporary pigments and executed with reversible paint layers. Nevertheless, Viktor Melnikov is not satisfied with some of the results. We have to show respect to his views and we have to try harder to come up to the level of the mastery of Konstantin and Viktor Melnikov.

In order to understand the contradiction between what we can see and what Viktor Melnikov explains, it is necessary to collect and to record the scientific facts. In 2018, the basic principle was quantified.[i] Basic principle is to leave the current finishes intact. Architectural paint research, starting with scientific research of samples of the paint layers in the Melnikov House is the contribution we will offer within the framework of the grant agreement between the Schusev State Museum of Architecture and Getty Foundation for technical survey and preparation of a conservation plan for the Melnikov House. [ii]

Within this frame, it was possible to collect 120 paint samples , to analyse 18 paint samples and to arrange data.

This report contains the analyses of 18 paint samples and archival research based on materials provided by the Melnikov House Museum.

The information (in English) allows to get a broader view, as well as the photos, paintings and drawings which are supplied by Pavel Kuznetsov, Director of State Melnikov museum.

Recommendations

The architectural paint research serves as a basis for two goals :

1. To match the quality of the paint layers in colour , structure and character
2. To support facts and details of the residential history and alterations

The analysis of 18 samples is just a start. We recommend to continue the analysis.
It will not be necessary to analyse all samples. Due to the distance, we collected an ample amount of samples, which allow us to continue the work in the laboratory in Amsterdam. The samples of the first and the second visit partly overlap.

It will be necessary to check the analyses in the Melnikov House. For example MHM 101, dado of the wall behind the stove in the kitchen, to understand the chronology of the damaged paint layers of the dado.
Another scope could be the painter's manuals in Russia in the early 1920's.
The starting point of the reconstruction of the paint layers on panels, based on te analysis and the situation in the Melnikov House remains.
The present situation of the Melnikov House will be accepted, to start with. The quality of the original finishes will be explained to visitors by demonstrating the separate specimen.
The reconstructions will allow the staff to develop the vision on the Melnikov House Museum.

Chronology of the Melnikov House and Inhabitants

Focussing on the colours, the following facts [lit.1, pp 211-217] are relevant:

1929	finishing of the facades and interiors
1929	Sep : The Melnikov family of four moves into house : architect Konstantin Melnikov, Anna Melnikova (Gavrilovna), Lyudmila (16) and Viktor (14).
1933	Lyudmila marries and leaves the house
1940	Viktor marries
1941	23 July : an aerial bomb damages the Vakhtangov Theatre on the Arbat, the force of the explosion smashed the windows of surrounding houses, including Melnikov's house
1941-1944	The family spends the winter in the basement, furnished with 2 beds, stove (cooking). In 1944 they move to the ground floor of the large cylinder. All the windows in the house are covered with whatever materials come to hand , this remains till the end of the war.
1948-1950	Several partitions and the built-in cupboard on the ground floor of the large cylinder are dismantled.[the two children's room became one; the partition between the former cloakroom and the room occupied by the lady of the house was dismantled, stove was set aside in the corridor for Anna. Bathroom and toilet were used by all.] In the bedroom the original bed podiums and the plaster on the floor are removed. Renovation of the wall plaster and ceiling is carried out. Wallpaper is pasted over the walls and white paper on the ceiling. (…) In the summer the ground floor of the large cylinder is repaired. Walls and ceilings are treated with a copper sulphate solution and covered with fresh whitewash. In the children's rooms and toilet the ceilings and the yellow wall are repainted; new wallpaper is put in the dining room
1950-late 1950s	Viktor Melnikov's wife and daughters Elena (Lena) and Ekaterina (Katya) move into the house. Viktor's family lives in two rooms on the ground floor until the late 1950s.
1952	Separate entrance is built in the kitchen, replacing the built-in cold-storage cupboard
1964	Repair work on the roof
1965-1974	Konstantin Melnikov is rehabilitated and publicly acknowledge
1974	November 28 : Death of Konstantin Melnikov
1976	repair of the facades, the windows sashes are painted dark brown and the external windowsills a silvery colour. The facades are wiped with a cement solution and painted white. The building acquires a lustre inconsistent with the original concept.
1977	August 8 : Death of Anna Melnikova
1980-1988	Special Project Restoration
1989	Start restoration . after the roofing and ceiling above the large cylinder have been dismantled work is halted due to insufficient funding
1990	Kitchen door removed and replaced by built-in cold-storage cupboard in accordance of original project
1992-1993	Replace the roof structures of the large cylinder and restore the roof of the small cylinder. Further work is halted
1994-2014	large-scale commercial buildings around the house interferes with the natural lighting and hydrogeology. The original views from this house are lost.
1996-1997	Restoration on the house by the Restoration Experimental Engineering Workshop 5
2006	February 5 : Death of Viktor Melnikov
2006-2014	February 2005 - October 2014 : Ekaterina takes up residence
2014	February : State Museum of Konstantin and Viktor Melnikov is founded as a branch of Schusev State Museum of Architecture

Interview Viktor Melnikov by Oleg Adamov 2000/2001

Façade
The paint on the house's exterior walls has started to come off, in places together with the plaster. Parts of some walls have become covered with a web of threadlike cracks.

Windows
'Viktor Melnikov considers a (…) failure of the restoration project to be the new method used to paint the windows – a method which has changed the way the windows look. During restoration oil paint was replaced with enamel .
To begin with, pure olifa [heat-treated linseed oil] was warmed and rubbed into the wood in order to treat it and strengthen the window frame. Then 2-3 thin layers of oil were rubbed in. This gave a zinc white colour. As the oil settled, its surface turned matt – as opposed to the eye-catching gloss created by enamel – and took on a more attractive appearance. The oil had a more transparent, less graphic, more picturesque look and the window transoms merged organically with the interior – in keeping with the picturesque image sought by Konstantin Melnikov. "the effect is of something made by no human hand". The same advice to use oil paints applies to the glazed partition wall and the living-room door.'

Octahedronal [sic] window
We should note KM's non-Constructivist approach to the functioning of the octahedronal window in the living room. Here functionality of operation has clearly been sacrificed to the creation of a full and impressively integral feeling of the living room interior as a space.

Specimens
The basement contains surviving specimens of the colours used to paint the interiors of the house.

Wallpaper
The wallpaper in the dining room has started to come off the walls.

Plaster
Due to the fact that during the course of restoration work partition in the bedroom of the 2nd floor was pressed into the floor below it and the integrity of the floor itself violated, a sizeable fragment of plaster has come off the ceiling in the toilet room and the lathing is exposed. Plaster continues to come off.

Paint layers

Pre-conservation research report (1996) and report on implementation conservation works (1997)[Lit 4] are based on the Atlas of Architecture Colors. USSR Academy of Achitecture, Moscow, 1937 [Lit.5] but sometimes modified (for example diluted with more parts of chalk). translation by Pavel Kuznetsov

Overview Archival Information

19-051-1 (MHM 101)   kitchen, dado of the wall behind the stove
Interview Oleg Adamov [2] : 'Walls : in 1929: painted from floor to ceiling, Colour: white, Interview [3] : in 1929: Painted with oil-based paint: white. From the floor to the ceiling , in 2005: 'painted from the floor to the middle of the window', white

19-051-2 (MHM 122)   boy's room, blue triangle on the ceiling
Interview Adamov: Ceiling paint in children's cabins: these paints are more or less successful, Colour: dark-blue ultramarine , yellow chrome. Comments: Very successful. Just right
Interview: in 1929: Ultramarine blue, in 2005: Paint coat is good
[4. Page 39]   2 - ceiling in kid's room (cobalt blue 1 part + chalk 0,5 part, #449)

19-051-3 (MHM 124) girl's room, yellow triangle on the ceiling
Interview Adamov[2]: Ceiling paint in children's cabins: these paints are more or less successful, Colour: dark-blue ultramarine , yellow chrome. comments: Very successful. Just right
Interview [3]: in 1929:, yellow chrome, oil paint; in 2005: paint coat is good
[4. Page 39] 1 - ceiling and wall in a kid's room (yellow medium 1 part + chalk 16 parts, #411)

19-051-4 (MHM 61) dressing room, red surface on the ceiling
Interview Adamov[2] : comments: in order to restore the life of past years, it's necessary to reunify the two adjoining rooms to create a single space, as was the case during the several decades just gone. This was my space, where I had my table, bed, a display of works, and holy corner. The shelving and cupboard should be removed.
Interview [3]: in 2005: partially collapsed. Proposal: Repair
[4 page 39] 3 - ceiling in wardrobe/changing room(krapp-lacque light 1 part + mars brown dark + chalk 3 parts, #380)

19-051-6 (MHM134) dressing room, closet between dressing room and girl's room, right part
Interview Adamov [2]: Left (male) fitted cupboard. Paint. Colour: Yellow, chrome, comments: Not so bright.
Interview [3]: in 1929 : Light ochre, oil paint ; in 2005: Painted with white enamel. Proposal: repaint
[The right wardrobe (women's clothing) was .Proposal:: restore

19-051-5 (MHM118) dining room, window frame of inner window, interior side
Interview Adamov [2] : All paint on interior wood . oil paint, heat-treated oil. Colour: white
Interview [3]: in 1929 ; in 2005: see : studio

19-051-7 (MHM145) living room, octagonal window, inner window, interior side -

19-051-8 (MHM147) living room, doorframe to stairs
Interview Adamov [2]: door into the living room, The door was painted so that the base coat showed through. The paint was more transparent, lighter, so that the base coat showed through. The thickness of the paint should be diluted with a touch of whitening. Colour: Brown, umbra. Comments: the colour was a lighter shade of brown, a lighter burnt umbra. The paint should be less graphic.
Interview [3]: in 1929 : Door : Burnt umber, light ; in 2005: Dark paint Two glasses cracked. Proposal:: Repaint

19-051-9 (MHM162) painting of the bedroom by Viktor Melnikov, 'golden' finisch layer
19-051-10 (MHM171) bedroom, golden wall, behind mirror
19-051-12 (MHM172) bedroom, golden wall behind the sofa
Interview Adamov [2]: Walls. Comments: paint is satisfactory
Interview [3]: in 1929 : There is a sample of -golden-yellow polished paint remaining ; in 2005: Paint coat: golden-yellow, rough. Comments: restore the polished plaster
[4. Page 40] 11 – bedroom (chrome lemon 18 parts + umber dark 0,5 part + chalk 7 parts, #163). 'Italian stucco' with polishing of finishing layer with marble powder and wax

19-051-11 (MHM173) exterior, window to the right of the entrance door
Interview [3]: External curtain wall: frames, transom latches in 1929 : Coat of oil paint over oil varnish. Umber, light tone ; in 2005: Frames are cracked. Enamel paint colour has been changed. Comments : Fit, clean and repaint the frames

19-051-13 (MHM163) studio, yellow cylindrical wall with green plaster under the paint layers
Interview Adamov [2]: Part of the cylinder of the stairwell. Paint a denser colour. Try to make heavier. Colour: Chrome yellow

[4. Page 40] 12 - wall of the staircase in the studio. (cadmium yellow medium 1 part + chalk 16 parts, #411)

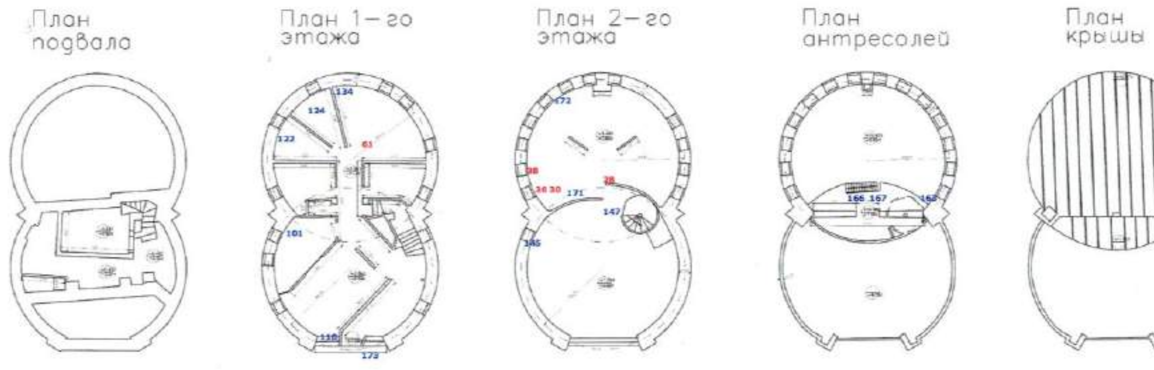
19-051-14 (MHM166) studio, white balustrade of the entresol, white vertical post
Interview [3] Edge of the mezzanine ; White oil paint. In 2005 : Painted with white enamel, Proposal: repaint

19-051-15 (MHM167) studio, yellow balustrade of entresol, middle post
-

19-051-16 (MHM30) bedroom, first window west, inner window, top window, interior side
19-051-17 (MHM36) bedroom, fist window west, outer window, interior side
19-051-18 (MHM38) bedroom, second window west, inner window, interior side
Interview Adamov [2]: (windows in general) .oil paint, heat-treated oil.
Window frames : oil paint settles in a different way and yields a more attractive appearance – matt as opposed to gloss. Oil sinks further into the wood and strengthens the frames. Colour: Brown, lighter. Comments: looks to graphic, not organic, too fragmentary
Interview [3]: studio frames. in 1929 : Paint coat: white oil paint; in 2005: Painted with enamel paint. Some of glasses are broken; Proposal: Replace the glass. Paint the frames.

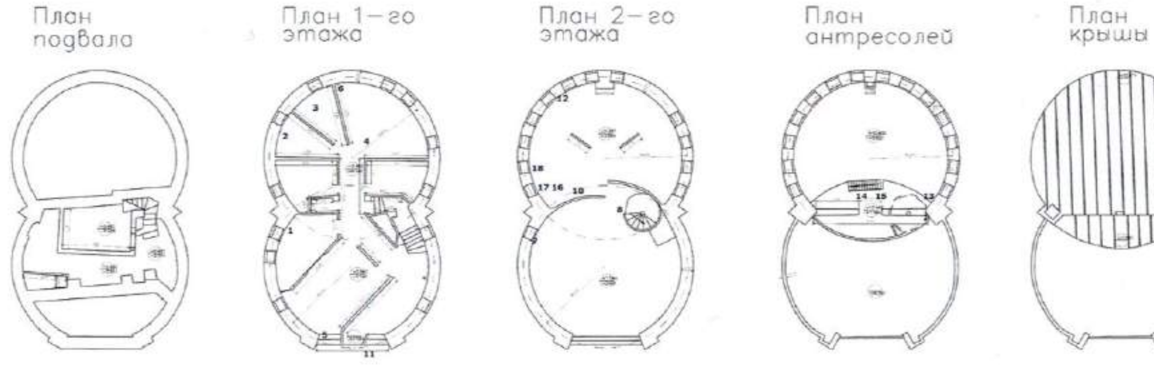
Literature

1: Kuznetsov, Pavel. *The Melnikov House. Icon of the avant-garde, Family Home, Architecture Museum.* Berlin, 2017
2: Melnikov, Viktor and Oleg Adamov. The present condition of the Melnikov House. *Heritage at risk*. Moscow, 17-20 April 2006
3: The survey had been carried out during 2002-2005 with direct participation of the owner of the house V.K. Melnikov, the son of architect K.S. Melnikov, and the students of Moscow State Academy of Municipal Economy and Construction Ye.I. Yazhlevaya and S.Yu. Logunova
4: Pre-conservation research report (1996) and report on implementation conservation works, (1997).
5: *Atlas of Architecture Colors*. USSR Academy of Achitecture, Moscow, 1937.



analysed samples Melnikov House Moscow **MHM**

MELNIKOV HOUSE MOSCOW _ ARCHITECTURAL PAINT RESEARCH _ SAMPLING JAN 2018 FEB/MARCH 2019



analysed samples Melnikov House Moscow **19-051-**

MELNIKOV HOUSE MOSCOW _ ARCHITECTURAL PAINT RESEARCH _ SAMPLING JAN 2018 FEB/MARCH 2019

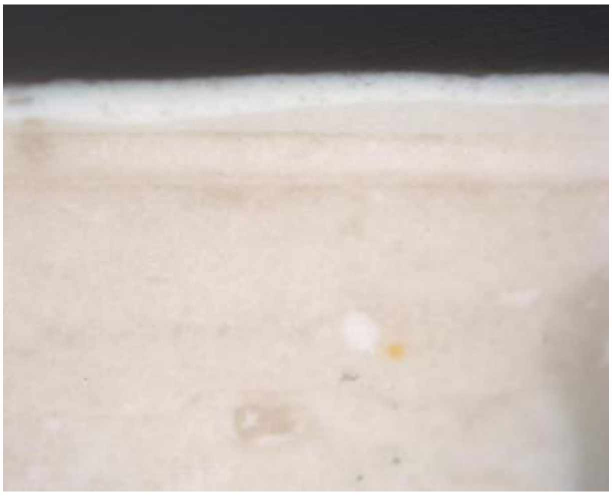
List with samples, analysed in the laboratory

Sample number *		
19-051-1	(MHM 101)	kitchen, dado of the wall behind the stove
19-051-2	(MHM 122)	boy's room, blue triangle on the ceiling
19-051-3	(MHM 124)	girl's room, yellow triangle on the ceiling
19-051-4	(MHM 61)	dressing room, red surface on the ceiling
19-051-5	(MHM118)	dining room, window frame of inner window, interior side
19-051-6	(MHM134)	dressing room, closet between dressing room and girl's room, right part
19-051-7	(MHM145)	living room, octagonal window, inner window, interior side
19-051-8	(MHM147)	living room, doorframe to stairs
19-051-9	(MHM162)	painting of the bedroom by Viktor Melnikov, 'golden' finishing layer
19-051-10	(MHM171)	bedroom, golden wall, left from entrance, behind mirror
19-051-11	(MHM173)	exterior, window to the right of the entrance door
19-051-12	(MHM172)	bedroom, golden wall behind the sofa
19-051-13	(MHM163)	studio, yellow wall with green plaster under the paint layers
19-051-14	(MHM166)	studio, white balustrade of the entresol, white vertical post
19-051-15	(MHM167)	studio, yellow balustrade of entresol, middle post
19-051-16	(MHM30)	bedroom, first window west, inner window, top window, interior side
19-051-17	(MHM36)	bedroom, fist window west, outer window, interior side
19-051-18	(MHM38)	bedroom, second window west, inner window, interior side

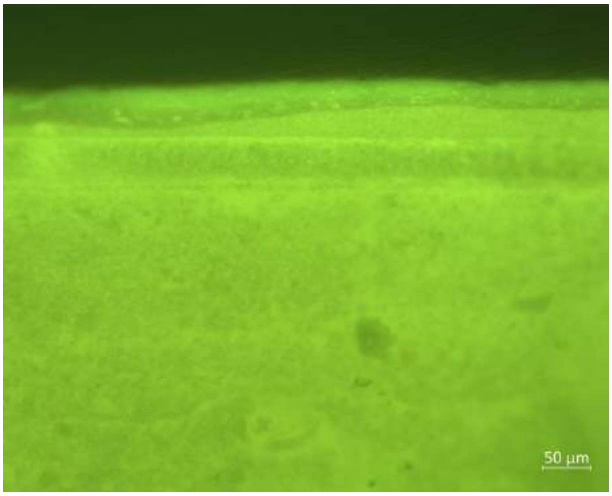
**Laboratory sample numbers : 19-051-1*
Sampling in situ numbers : MHM (Melnikov House Moscow)

Results and Discussion

Sample number 19-051-1 (MHM 101) kitchen. dado of the wall behind the stove

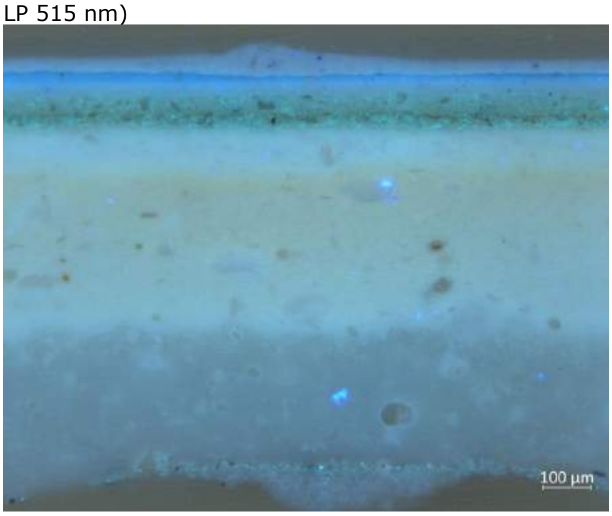


Microphotograph of the paint cross section under incident polarized light



Fluorescence microphotograph of the paint cross section (exitation filter BP450-490 nm; emission filter LP 515 nm)

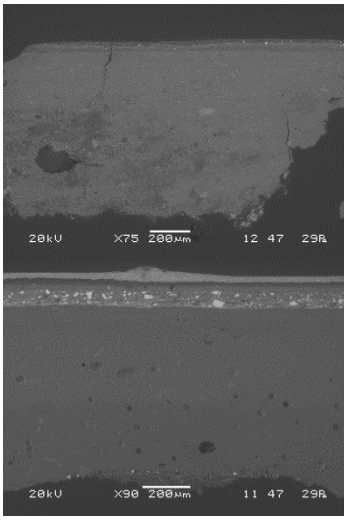
Microphotograph of the paint cross section under incident polarized light



Fluorescence microphotograph of the paint cross section (exitation filter BP365/12 nm; emission filter LP 397 nm)

SEM-EDX results

Layer x+4: white paint layer:	Ti Ca Si (Mg) (Al)
Layer x+3: white paint layer:	**Ti Si Ca** Mg Al
Layer x+2: white paint layer:	**Ca** Ti
Layer x+1: whitewash layer:	**Ca**
Layer x: thick whitewash layer:	**Ca**
Layer 9: white paint layer:	**Zn** S Ba Ca
Layer 9: blue pigment grains:	**Na Al Si S** (K)
Layer 8: dark(ened) paint layer:	**Zn**
Layer 7: white paint layer:	**Zn**
Layer 6: beige paint layer:	**Zn Ca S** Ba
Layer 5: thin grey paint layer:	**Zn Ca S** (Ba) (Si) (Al)
Layer 4: white whitewash layer:	**Ca**
Layer 3: beige whitewash layer:	**Ca**
Layer 2: brownish whitewash layer:	**Ca**
Layer 1: very thin light brown paint layer:	**Ca** S Si Al Zn
Layer 0: plaster layer:	**Ca**



On a small fragment of a plaster layer consisting of chalk a very thin light brown paint layer is visible, containing zinc white, chalk or gypsum and a little ochre (first finishing stage?). On this layer lies a thick brownish whitewash layer (carbonated lime) followed by a beige whitewash layer and a white whitewash layer. Each whitewash layer might have been a finish layer or applied together.

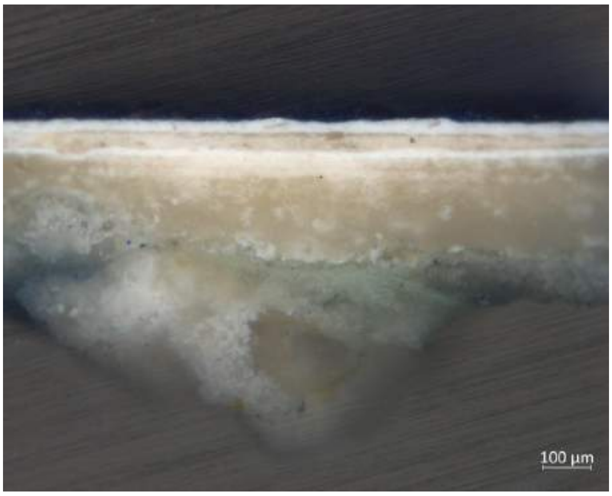
After some time a thin grey paint layer was applied, containing zinc white, chalk or gypsum, a little medium coarse barium sulphate and very little aluminium silicate, possible an ochre. This layer probably was a finish layer. It is followed by a beige paint layer of zinc white, chalk or gypsum and medium coarse barium sulphate. This layer was applied as a finish layer.

The next paint layer was white or very light blue and consists of zinc white and probably very little synthetic ultramarine blue. This layer is covered by a dark layer with zinc white, possibly not a separate paint layer but darkening of the top of the same white or very light blue paint layer. The next finish consists of a single light blue paint layer consisting of zinc white, very fine barium sulphate and a little synthetic ultramarine blue.

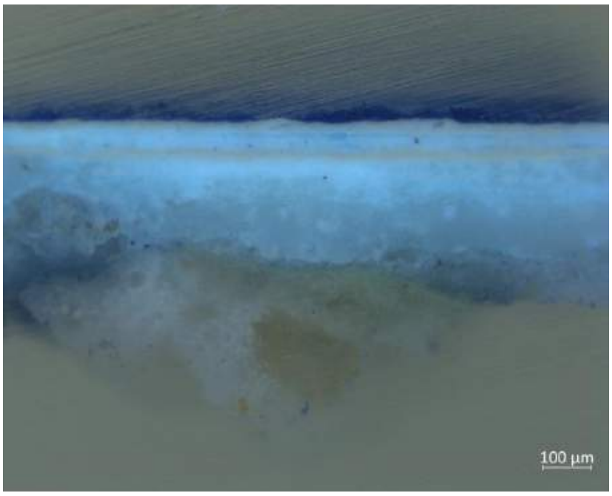
A second paint fragment consists of thick whitewash layer and a much thinner whitewash layer (one or two finishing stages), followed by a thin layer of ground paint containing chalk and titanium dioxide and a white finish layer consisting of titanium dioxide, chalk and a magnesium aluminium silicate filler. This is covered by a white finish layer with the same pigments, but with more binding medium than the previous paint layer.

Archival Research:
The first goal of this sample is to understand the chronology of the paint layers, currently visible due to the damage of using the stove.
Whether the walls were totally white (interview Viktor Melnikov with Oleg Adamov (2000/2001),[2] or there was a dado from the start, is not clear. Analysis of the sample of the wall of the kitchen will help to interpret this sample.

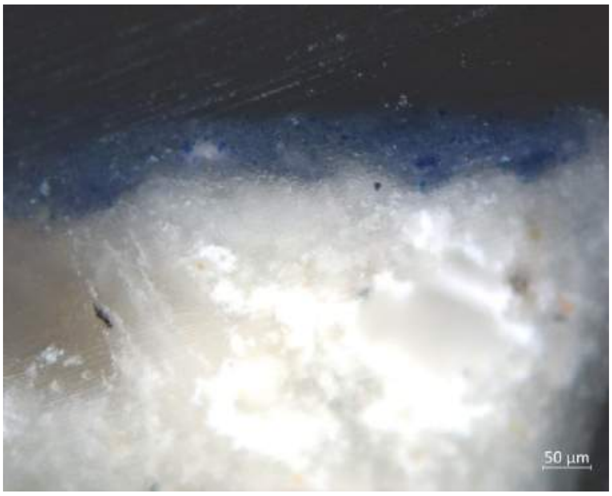
Sample number 19-051-2 (MHM 122) boy's room, blue triangle on the ceiling



19-051-2a Microphotograph of the paint cross section under incident polarized light



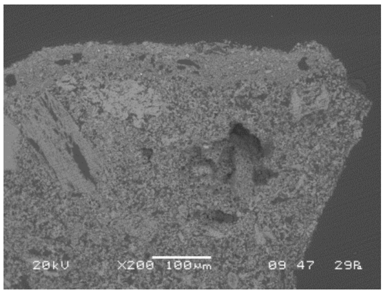
19-051-2a Fluorescence microphotograph of the paint cross section (exitation filter BP365/12 nm; emission filter LP 397 nm)



19-051-2b Microphotograph of the paint cross section under incident polarized light

SEM-EDX results

Layer 10: blue partial paint layer:	**Na Al Si S** Ca
Layer 9: white paint layer:	**Ti Si Mg Ca** Al (S) (K)
Layer 8: greyish paint layer:	**Ca**
Layer 7: very thin white paint layer:	**Ti Si Mg Ca** Al (S) (K)
Layer 6: whitewash layer:	**Ca**
Layer 5: white or light blue layer:	**Ca S**
Layer 4: greenish layer:	**Ca S** Si
Layer 3: plaster layer:	**Si Ca** Al S K
Layer 2: blue paint layer:	**Ca** (Na) Al Si S
Layer 2: blue particle:	**Al Si** (Na) S
Layer 1: white plaster:	**Ca S** (Si)



The original blue triangle in the boy's room was painted with a blue lime paint containing synthetic ultramarine blue on a white plaster layer, consisting of gypsum.

It was covered by a plaster layer (3) consisting of lime, sand and some clay minerals on which lies a greenish layer (4) of gypsum and probably a copper compound (although copper could not be detected in this layer). This is covered by a white or light blue layer (5) of gypsum with very little blue pigment. The greenish layer probably corresponds to the green plaster layer in the overpaint of the cylindrical yellow wall in the studio (sample number 19-051-13) and the copper containing plaster layer in sample 19-051-3 from the yellow triangle in the girl's room.

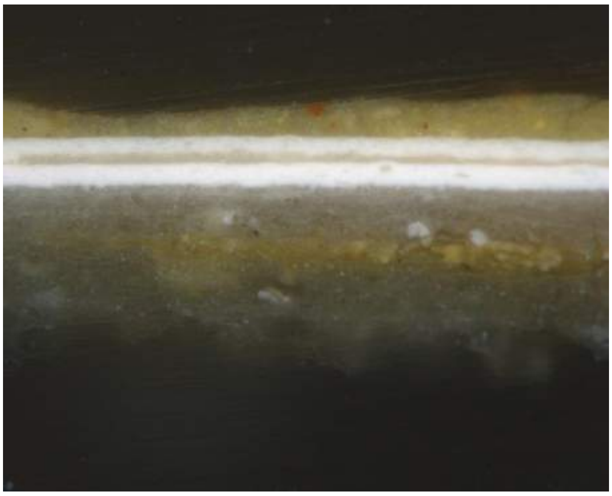
This white or light blue finish was covered by a whitewash layer (6) on which a thin white paint layer (7, with a yellow fluorescence, fig. B) was applied, consisting of titanium dioxide, magnesium silicate (talc), chalk and some clay mineral.
On this white paint layer a layer of ground paint consisting of chalk or lime and an organic binder (8) was applied followed by a white paint layer (9) consisting of titanium dioxide, magnesium silicate (talc), chalk and some clay mineral, probably the same paint as paint layer 7. On this white paint the final blue paint layer (10) consisting of synthetic ultramarine blue is partially present.

Archival research:
During the period 1948-1950 : ‘In the summer the ground floor of the large cylinder is repaired. Walls and ceilings are treated with a copper sulphate solution and covered with fresh whitewash. In the children’s rooms and toilet the ceilings and the yellow wall are repainted;’ (Kuznetsov, 2017). This corresponds to the greenish layer (layer 4).

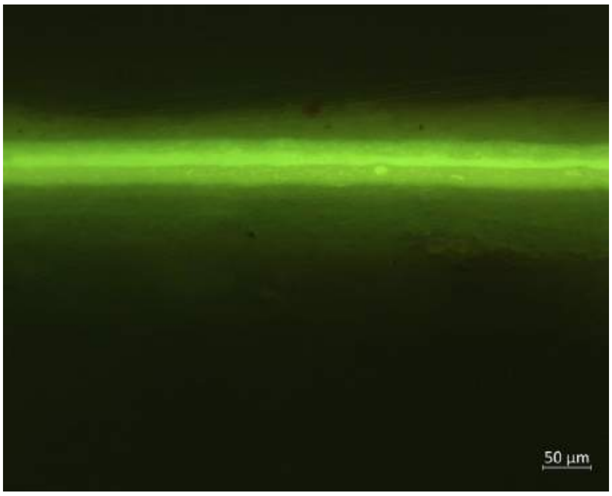
‘Interview Adamov[2]: Ceiling paint in children’s cabins: these paints are more or less successful, Colour: dark-blue ultramarine . Comments: Very successful. Just right’ This corresponds to the blue layer on top (layer 10)

Interview[3]: in 1929:’ Ultramarine blue, in 2005: Paint coat is good’. This corresponds to the original blue layer (layer 2)

Sample number 19-051-3 (MHM 124) girl's room, yellow triangle on the ceiling



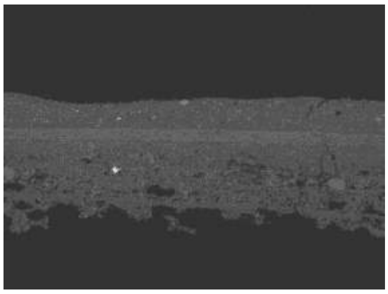
Microphotograph of the paint cross section under incident polarized light



Fluorescence microphotograph of the paint cross section (exitation filter BP450-490 nm; emission filter LP 515 nm)

SEM-EDX results

Layer 8: yellow paint layer:	**Ca** Si Al (Zn)
Layer 8: yellow pigment particles:	**Si Al Fe**
Layer 7: white paint layer:	**Ti Ca** (Si) (Mg) (Al)
Layer 6: greyish paint layer:	**Ca**
Layer 5: white paint layer:	**Ti Ca** (Zn) (Si) (Mg) (Al)
Layer 4: greyish transparent layer:	**Ca**
Layer 3: yellow paint layer:	**Ca** S Al (Si)
Layer 2: greyish transparent plaster layer:	**Ca** S (Cu)
Layer 1: plaster layer:	**Ca** S



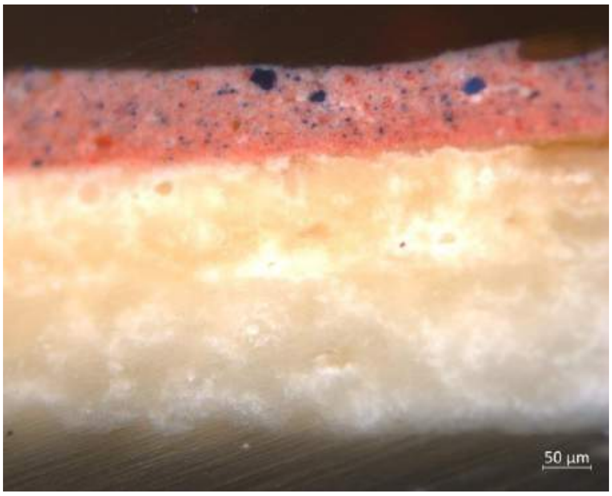
On a partially present plaster layer (1) lies a greyish, rather transparent, plaster layer (2), containing chalk and gypsum and a small amount of a copper compound. This probably gave this layer a light green appearance. This is covered with a yellow lime paint (3), probably containing an organic yellow on an aluminium containing substrate. The greyish, copper containing layer probably corresponds to the greenish layer (4) of the second finishing stage in the sample of the blue triangle (19-051-2) and the green copper containing layer in sample 19-051-13 from the cylindrical yellow wall in the studio. This indicates that paint layers of the original yellow triangle are not present in this sample. Maybe sampling has not been deep enough to incorporate the original yellow in the sample or the original was not present (anymore) at the sample location.

The yellow paint was overpainted with a greyish, rather transparent, lime layer (4), followed by a thin white paint layer (5), consisting of titanium dioxide, magnesium silicate (talc), chalk and some clay mineral. On this white paint layer a layer of ground paint consisting of chalk or lime and a fluorescing organic binder (6) was applied followed by a white paint layer (7) consisting of titanium dioxide, magnesium silicate (talc), chalk and some clay mineral, probably the same paint as paint layer 5. The currently visible yellow triangle was painted with a lime paint (8) containing yellow ochre.

Archival research:

During the period 1948-1950 : 'In the summer the ground floor of the large cylinder is repaired. Walls and ceilings are treated with a copper sulphate solution and covered with fresh whitewash. In the children's rooms and toilet the ceilings and the yellow wall are repainted; (Kuznetsov, 2017). This corresponds to the greyish, rather transparent, copper containing layer (layer 2). This means that the original yellow triangle is not present in this sample.

Sample number 19-051-4 (MHM 61) dressing room, red surface on ceiling

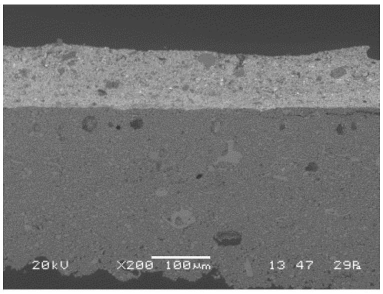


Microphotograph of the paint cross section under incident polarized light

No traces of an older surface were observed on the plaster fragment that was available after part of the ceiling had collapsed.

SEM-EDX results

Layer 2: purplish red paint layer: **Zn** Ca Al Si
Layer 2: blue pigment grains: **Na Al Si** S
Layer 1: white plaster layer: **Ca**



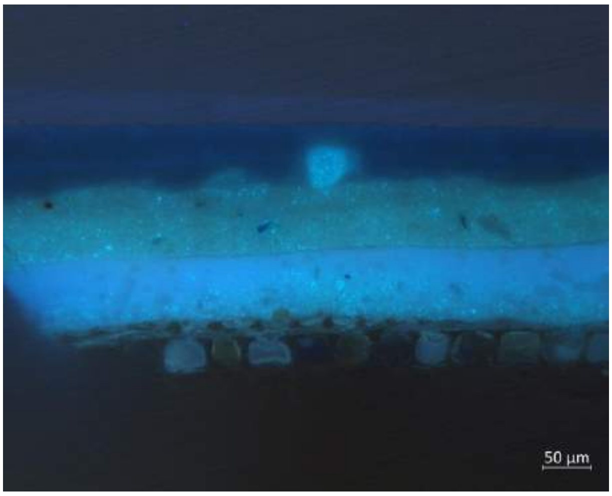
On a yellowish white plaster layer lies a purplish red paint layer, consisting of zinc white, some chalk, an organic red pigment and synthetic ultramarine blue.

Archival research

Based on the photos of the research 1996, it is clear that the plaster is reconstructed.
This can be confirmed by Interview [3]: in 2005: partially collapsed. Proposal: Repair

Sample number 19-051-5 (MHM118) dining room, window frame of inner window, interior side

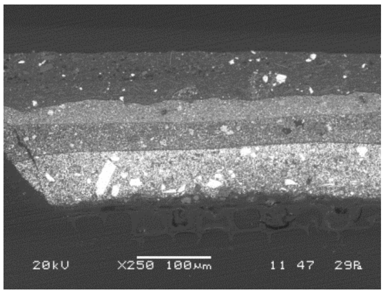
Microphotograph of the paint cross section under incident polarized light



Fluorescence microphotograph of the paint cross section (exitation filter BP365/12 nm; emission filter LP 397 nm)

SEM-EDX results

Layer 6: white paint layer:	**Ti Si Ca** (Zn) Mg Al (S) (K)
Layer 5: white paint layer:	**Ti Si Zn** Mg Al (S) (Ca) (K)
Layer 4: light greyish paint layer:	**Zn**
Layer 3: greyish paint layer:	**Zn**
Layer 3: blue pigment particle:	
Layer 2: white paint layer:	**Pb** Zn (Ba) (S)
Layer 1: white paint layer:	**Zn Pb** Ba S
Layer 1: coarse transparent particles:	**Ba S**
Layer 1: white pigment particles:	**Pb**
Layer 0: wood	



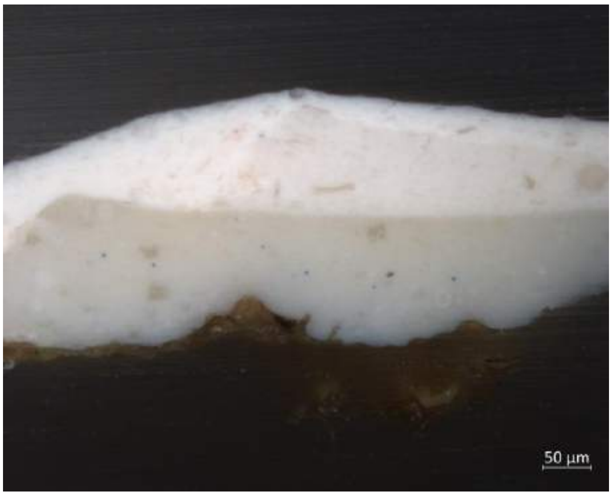
The wooden window frame was first painted white with a white paint layer (1) containing zinc white, lead white and barium sulphate and a white paint layer (2) of lead white, zinc white and little barium sulphate.

This finish was overpainted with a greyish paint layer (3) containing zinc white and very little synthetic ultramarine blue, followed by a light greyish paint layer (4) consisting of zinc white.

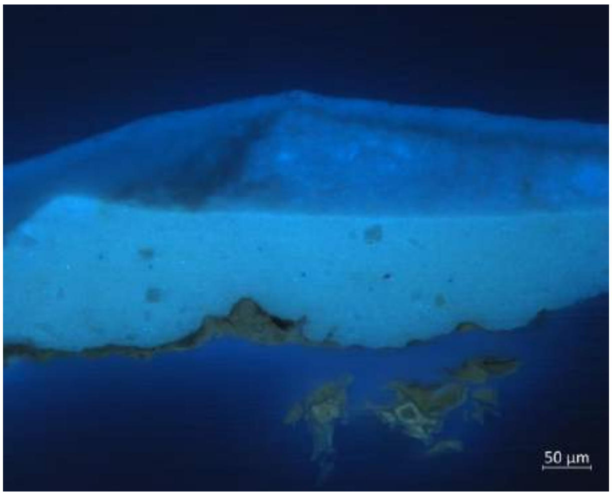
Finally the window frame was painted white with two white paint layers, the first (5) containing titanium dioxide, zinc white and magnesium and aluminium silicate fillers, the second (6) containing titanium dioxide, chalk and magnesium and aluminium silicate fillers.

These three phases correspond with the three phases in sample 19-051-16 and 19-051-18 of the windows in the bedroom.

Sample number 19-051-6 (MHM134) dressing room, closet between dressing room and girl's room, right part



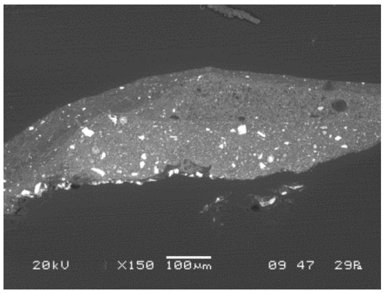
Microphotograph of the paint cross section under incident polarized light



Fluorescence microphotograph of the paint cross section (exitation filter BP365/12 nm; emission filter LP 397 nm)

SEM-EDX results

Layer 4: white paint layer:	**Ti Si** Mg Al
Layer 3: light greyish paint layer:	**Ca Ti Si** Mg (Al) (Zn) (S)
Layer 2: greyish paint layer:	**Zn** (Ba) (S)
Layer 1: traces of yellow paint layer:	**Ba S**
Layer 0: wood: a few cells	



Between the wood of which a few cells are visible and the white paint layer traces of a yellow paint layer are visible containing coarse barium sulphate. The white paint layer consists of zinc white and some barium sulphate and probably very little synthetic ultramarine blue. It is of a similar composition as the paint of the second finish in sample 19-051-5 of the window frame in the dining room.

This finish was overpainted with a white ground paint consisting of chalk, titanium dioxide, magnesium silicate and quartz followed by a white finish layer containing titanium dioxide (rutile) and talc as filler.

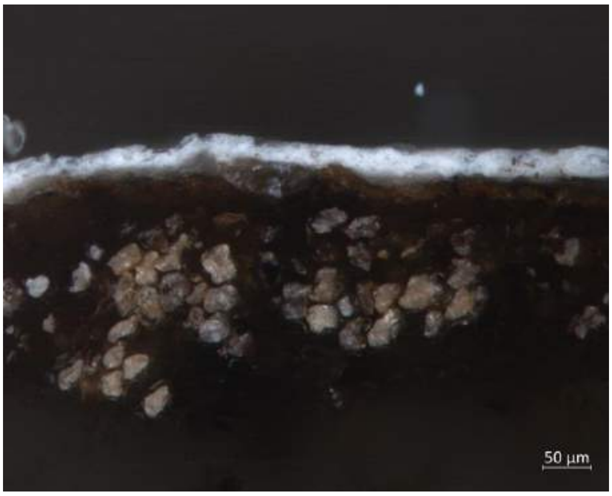
Archival research

Both interviews mention the yellow cupboard. Light ochre [3] is more likely, chrome is not.

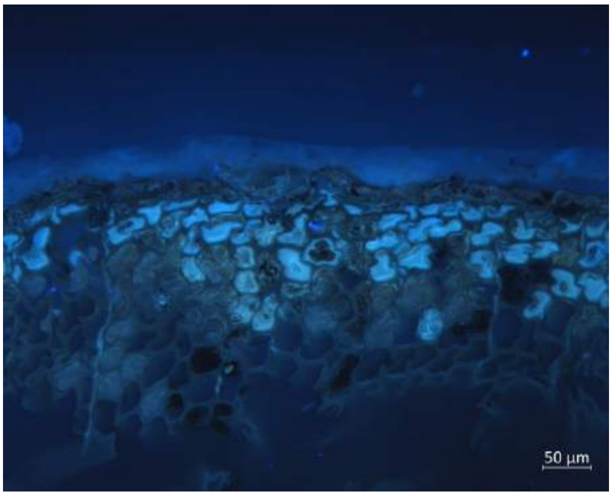
Interview Adamov [2]: Left (male) fitted cupboard. Paint. Colour: Yellow, chrome, comments: Not so bright.

Interview [3]: in 1929 : Light ochre, oil paint ; in 2005: Painted with white enamel. Proposal: repaint

Sample number 19-051-7 (MHM145) living room, octagonal window, inner window, interior side



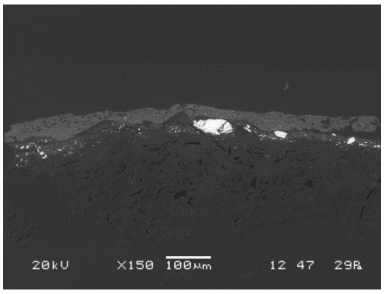
Microphotograph of the paint cross section under incident polarized light



Fluorescence microphotograph of the paint cross section (exitation filter BP365/12 nm; emission filter LP 397 nm)

SEM-EDX results

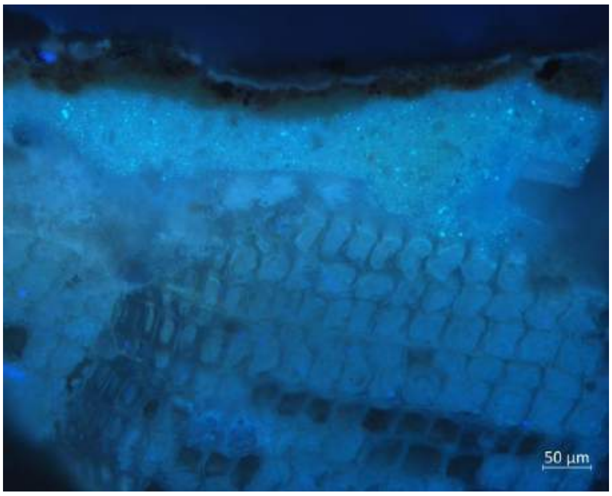
Layer 2: white paint layer:	**Si Mg Ca Ti**
Layer 1: dark brown paint layer:	Si Al Ca (Fe)
Layer 1: coarse transparent particles:	**Ba S**
Layer 0: wood	



The window was initially painted with a brown paint layer containing brown ochre, some chalk and some rather coarse barium sulphate particles. This brown finish was later overpainted with a white paint layer containing magnesium silicates or dolomite and quartz and titanium dioxide.

Sample number 19-051-8 (MHM147) living room, door frame to stairs

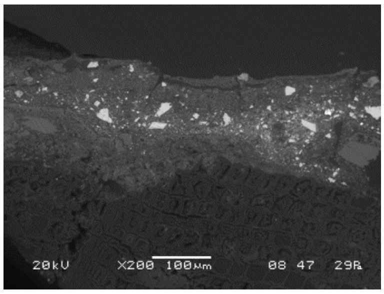
Microphotograph of the paint cross section under incident polarized light



Fluorescence microphotograph of the paint cross section (exitation filter BP365/12 nm; emission filter LP 397 nm)

SEM-EDX results

Layer 4: transparent fluorescing varnish:	**C**
Layer 3: red-brown paint layer:	**Ca Si Al** Fe
Layer 2: white paint layer:	**Zn** S Ca Ba
Layer 1: ground layer:	**Ca S**
Layer 0: wood	



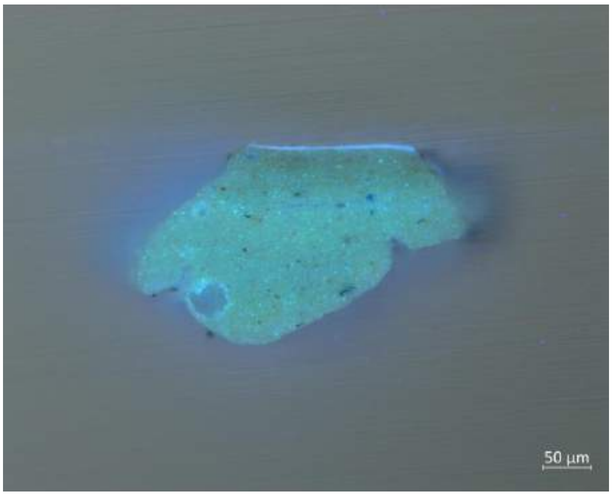
The wood of the door frame was primed with a white ground paint containing gypsum, followed by a white paint layer consisting of zinc white with little barium sulphate and chalk or gypsum. On this a red-brown paint layer was applied consisting of chalk and brown ochres. This layer was covered with a thin transparent and fluorescing varnish.

Archival research

Especially the interview by Adamov conforms the analysis: Interview Adamov [2]: door into the living room, The door was painted so that the base coat showed through. The paint was more transparent, lighter, so that the base coat showed through. The thickness of the paint should be diluted with a touch of whitening. Colour: Brown, umbra. Comments: the colour was a lighter shade of brown, a lighter burnt umbra. The paint should be less graphic.
Interview [3]: in 1929 : Door : Burnt umber, light; in 2005: Dark paint Two glasses cracked. Proposal:: Repaint

Sample number 19-051-9 (MHM162) painting of the bedroom by Viktor Melnikov, ‘golden’ finishing layer

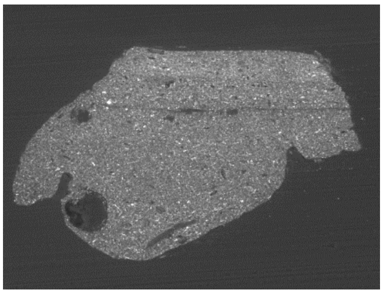
Microphotograph of the paint cross section under incident polarized light



Fluorescence microphotograph of the paint cross section (exitation filter BP365/12 nm; emission filter LP 397 nm)

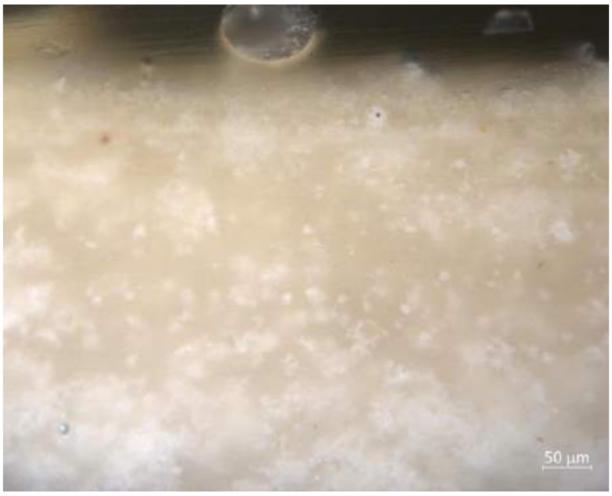
SEM-EDX results

Layer 4: thin fluorescent varnish	**C**
Layer 3: yellow paint layer:	**Zn** S (Pb) Si Al (Cr) (Fe) (Ca) (K)
Layer 2: yellow paint layer:	**Zn** S (Pb) Si Al (Cr) (Fe) (Ca)
Layer 1: yellow paint layer:	**Zn** S Al (Si) (Cr)



The ‘golden’ finishing layer of the bedroom is depicted in the painting with three layers of yellow paint of similar composition, containing zinc white, little zinc yellow, and possibly an organic yellow pigment. The top layer is covered with a very thin fluorescing varnish.

Sample number 19-051-10 (MHM171) bedroom, golden wall left from entrance, behind mirror

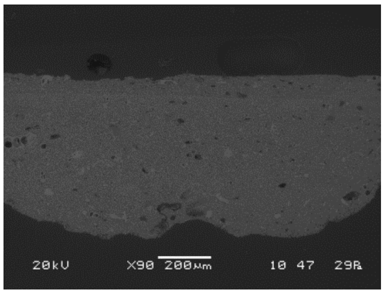


Microphotograph of the paint cross section under incident polarized light

Fluorescence microphotograph of the paint cross section (exitation filter BP365/12 nm; emission filter LP 397 nm)

SEM-EDX results

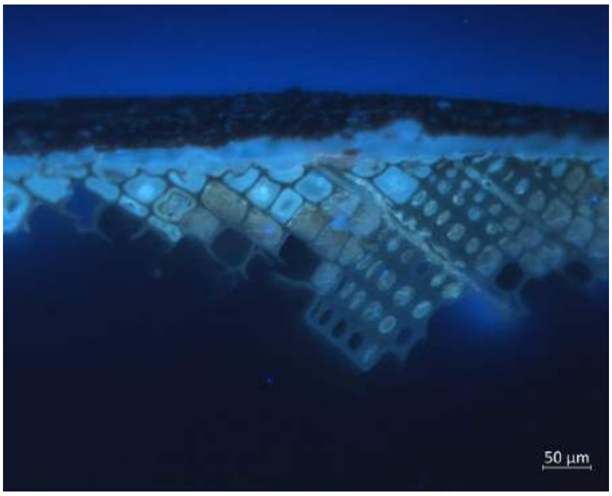
Layer 2: yellow (white) layer: **Ca**
Layer 1: plaster layer: **Ca**



The yellow walls in the bedroom were painted with a lime paint on a lime plaster layer. Surprisingly, no yellow pigment was found in the finish layer. Microscopically, the layer does not appear yellow in cross section.

Sample number 19-051-11 (MHM173) exterior, window to the right of the entrance door

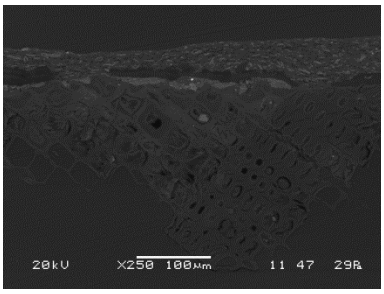
Microphotograph of the paint cross section under incident polarized light



Fluorescence microphotograph of the paint cross section (exitation filter BP365/12 nm; emission filter LP 397 nm)

SEM-EDX results

Layer 3: brown paint layer:	**Si** Mg Fe
Layer 2: transparent fluorescing varnish:	**C**
Layer 1: thin layer:	**Ca**
Layer 1: brown-red pigment particle:	**Fe**
Layer 0: wood	



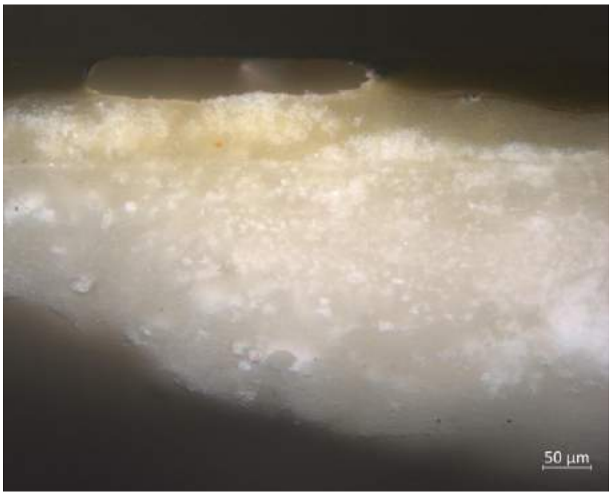
The window was originally painted with a thin layer of chalk and a little brown-red iron oxide and a transparent varnish, which fluoresces under UV-radiation. The structure of the wood was probably visible through these layers.
It was overpainted with a thick brown paint layer containing iron oxide brown, quartz and magnesium silicate as a filler.

Archival research

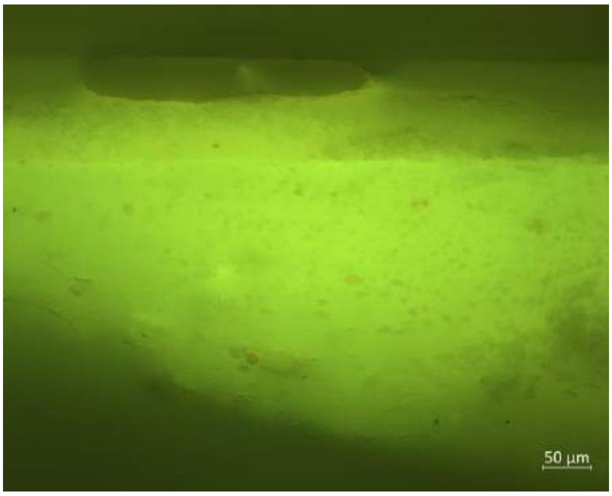
The interview could conform the analysis, though the varnish is not mentioned:

Interview [3]: External curtain wall: frames, transom latches in 1929 : Coat of oil paint over oil varnish. Umber, light tone ; in 2005: Frames are cracked. Enamel paint colour has been changed. Comments : Fit, clean and repaint the frames

Sample number 19-051-12 (MHM172) bedroom, golden wall behind the sofa



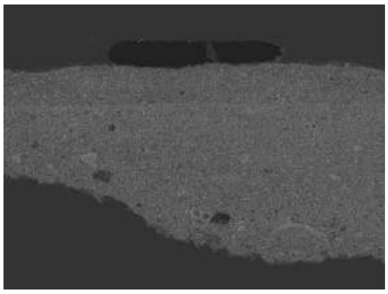
Microphotograph of the paint cross section under incident polarized light



Fluorescence microphotograph of the paint cross section (exitation filter BP450-490 nm; emission filter LP 515 nm)

SEM-EDX results

Layer 2: yellowish layer: **Ca** (Si) (Al)
  Layer 2: yellow pigment particle: **Fe** Si Al
Layer 1: white plaster layer: **Ca**



The yellow walls in the bedroom were painted with a lime paint on a lime plaster layer. One particle of yellow ochre was encountered in the lime paint. The amount of yellow pigment is very low for the colour of the layer as observed with the naked eye.

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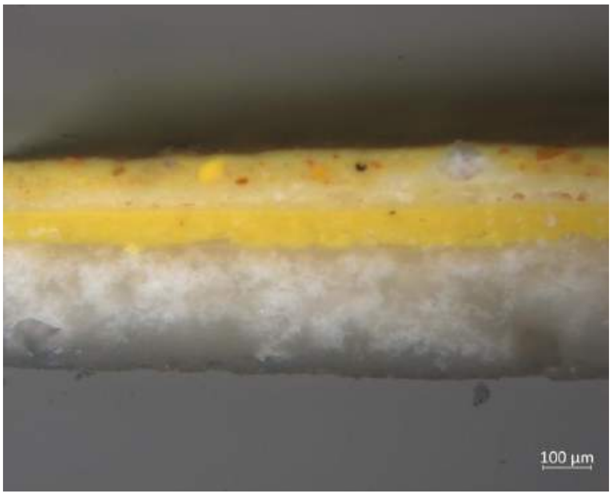
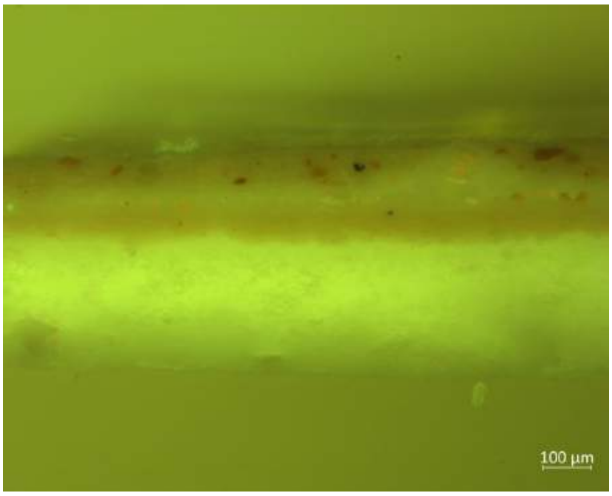
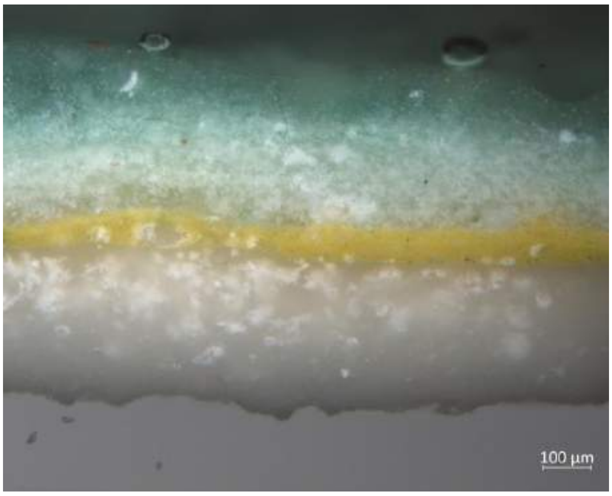
Sample number 19-051-13 (MHM163) studio, yellow cylindrical wall with green plaster under the paint layers



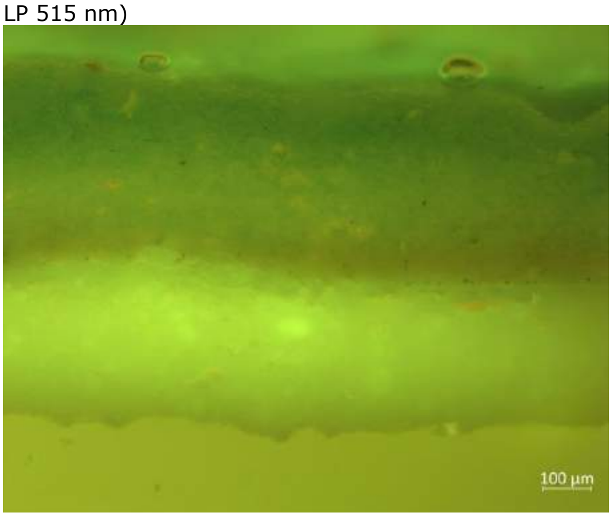
Microphotograph of the paint cross section under incident polarized light



Fluorescence microphotograph of the paint cross section (exitation filter BP450-490 nm; emission filter LP 515 nm)



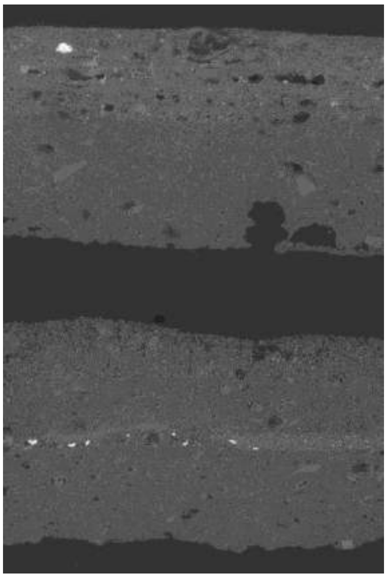
Microphotograph of the paint cross section under incident polarized light



Fluorescence microphotograph of the paint cross section (exitation filter BP450-490 nm; emission filter LP 515 nm)

SEM-EDX results

Layer 8: yellow paint layer:	**Ca** Zn Si (Al) (Fe)
Layer 8: orange yellow pigment particles:	**Si Fe** Al (K)
Layer 8: bright yellow pigment particle:	**C**
Layer 8: yellow pigment particle:	**Pb Cr**
Layer 7: white paint layer:	**Ca** Zn
Layer 6: yellow paint layer:	**Ca** Zn (Si) (Al)
Layer 5: white plaster layer:	**Ca**
Layer 4: green plaster layer:	**Ca** S Cu
Layer 3: white plaster layer:	**Ca**
Layer 2: yellow paint layer:	**Ca** (Pb) (Cr)
Layer 2: coarse transparent particles:	**Ba S**
Layer 2: very fine yellow pigment particles:	**Pb Cr**
Layer 1: white plaster layer:	**Ca**



The wall was first painted yellow with a yellow paint layer, probably a lime paint, containing some barium sulphate and chrome yellow as the yellow pigment.

Subsequently the wall was covered with a thin white plaster or whitewash and a green plaster, which contains a green copper compound. A similar layer is also present on the ceiling in the girl's room on the first (ground) floor (sample number 19-051-3).

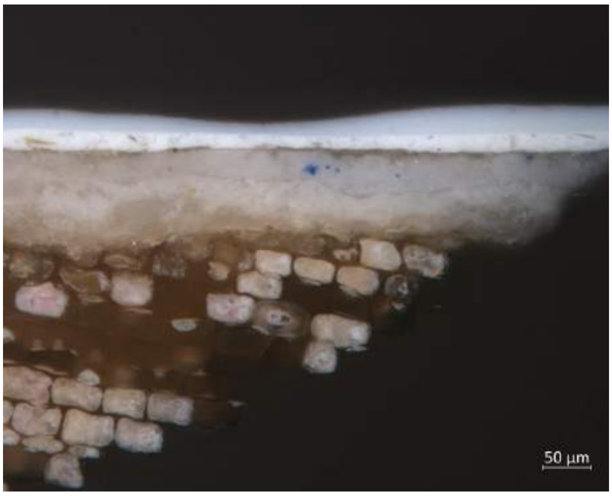
This was covered with a white ground of chalk and lime, on which a yellow lime paint layer containing zinc white and probably an organic yellow pigment.

After this the wall was painted yellow again with a thin white lime or chalk ground and a yellow lime paint layer containing zinc white, yellow ochres, little chrome yellow and little organic yellow pigment.

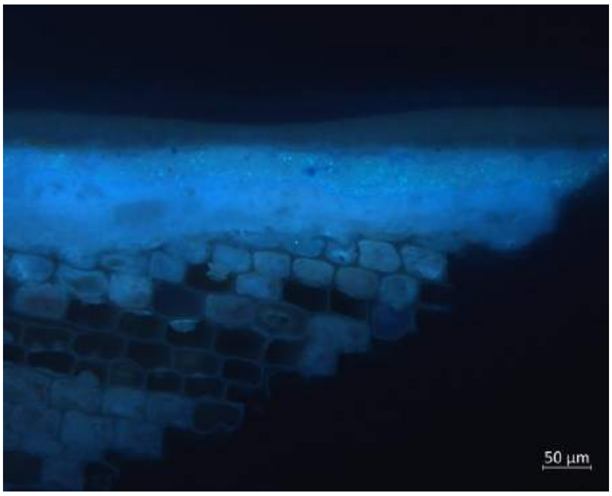
Archival research
'During the period 1948-1950 :'In the summer the ground floor of the large cylinder is repaired. Walls and ceilings are treated with a copper sulphate solution and covered with fresh whitewash. In the children's rooms and toilet the ceilings and the yellow wall are repainted; (Kuznetsov, 2017)
The green copper layer on the cylindrical wall would imply that the studio was treated with copper sulphate solution as well.
The interview conforms the analysis:

Interview Adamov [2]: Part of the cylinder of the stairwell. Paint a denser colour. Try to make heavier. Colour: Chrome yellow

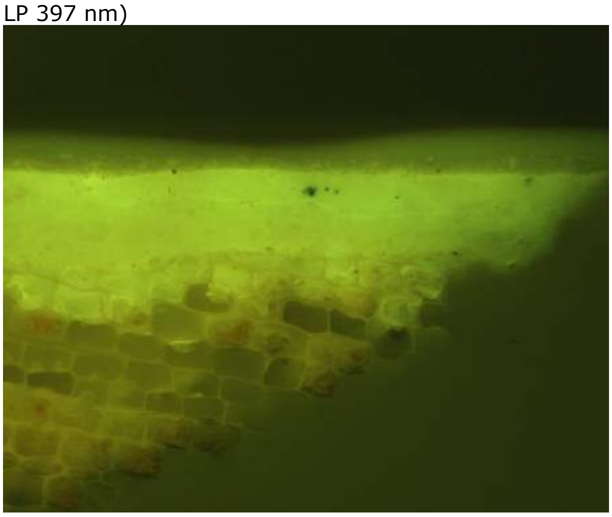
Sample number 19-051-14 (MHM166) studio, white balustrade of the entresol, white vertical post



Microphotograph of the paint cross section under incident polarized light



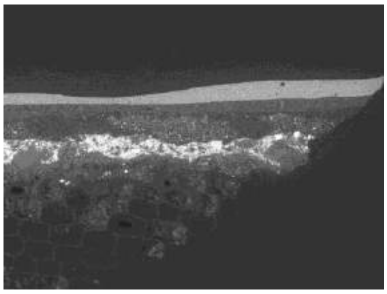
Fluorescence microphotograph of the paint cross section (exitation filter BP365/12 nm; emission filter LP 397 nm)



Fluorescence microphotograph of the paint cross section (exitation filter BP450-490 nm; emission filter LP 515 nm)

SEM-EDX results

Layer 5: white paint layer:	**Zn**
Layer 4: white paint layer:	**Ca Ti** Zn Mg (Al) (Si)
Layer 3: greyish white paint layer:	**Zn** S (Ca)
Layer 3: blue pigment particle:	
Layer 2: white paint layer:	**Pb** Zn Ba S Ca (Al) (Si)
Layer 1: transparent white ground layer:	**Ca**
Wooden support	



The post of the white balustrade was originally painted with a white ground layer containing chalk and a white finishing paint layer containing lead white, zinc white, some barium sulphate and little chalk.

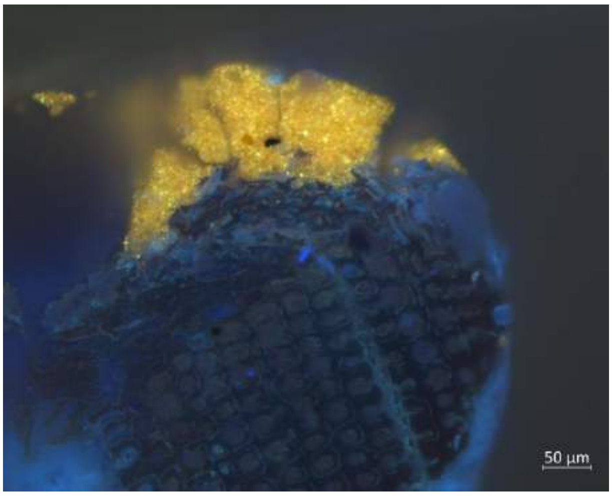
It was overpainted with a single greyish white paint layer of zinc white and very little blue pigment. This layer is similar to the first overpaint of the interior window in the dining room.

This finish was overpainted with a white paint layer containing chalk, titanium dioxide, zinc white and a magnesium containing compound, possibly dolomite. The post was finally overpainted with a white paint of zinc white.

Archival research
The paintings by Viktor Melnikov and late colour photos all show the colour white.

Sample number 19-051-15 (MHM167) studio, yellow balustrade of entresol, middle pos t

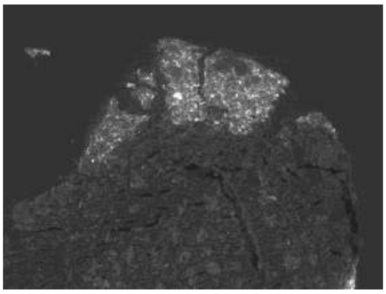
Microphotograph of the paint cross section under incident polarized light



Fluorescence microphotograph of the paint cross section (exitation filter BP365/12 nm; emission filter LP 397 nm)

SEM-EDX results

Layer 1: yellow paint layer: **Cd S** Zn (Cr)

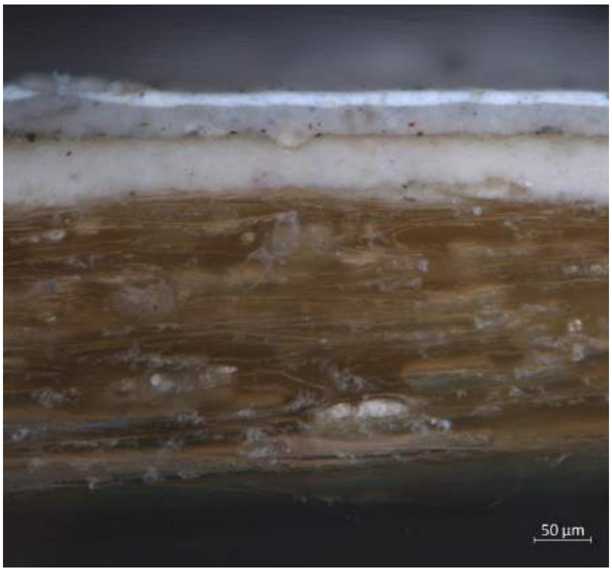


The yellow post of the balustrade was painted with a single yellow paint layer of cadmium yellow and some zinc white and probably some zinc yellow (zinc chromate).

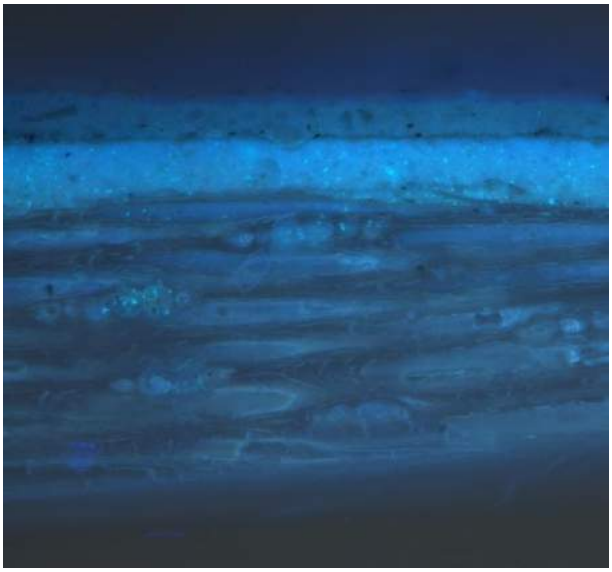
Archival research

The paintings by Viktor Melnikov and late colour photos all show the colour yellow. Cadmium yellow was also tested in the restoration of the 90s.

Sample number 19-051-16 (MHM30) bedroom, first window west, inner window, top window, interior side



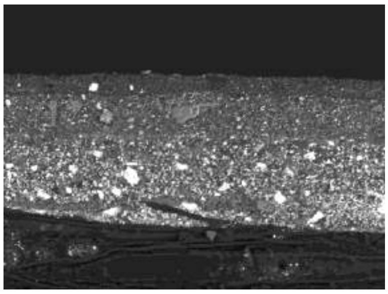
Microphotograph of the paint cross section under incident polarized light



Fluorescence microphotograph of the paint cross section (exitation filter BP365/12 nm; emission filter LP 397 nm)

SEM-EDX results

Layer 3: white paint layer:	**Si Ti** Mg (Zn)
Layer 2: grey paint layer:	**Zn** Ca S
Layer 2: red pigment particle:	Si Al
Layer 2: blue pigment particle:	?
Layer 1: white paint layer:	**Zn** Pb S Ca Ba
Layer 0: wooden support (tangential cut)	



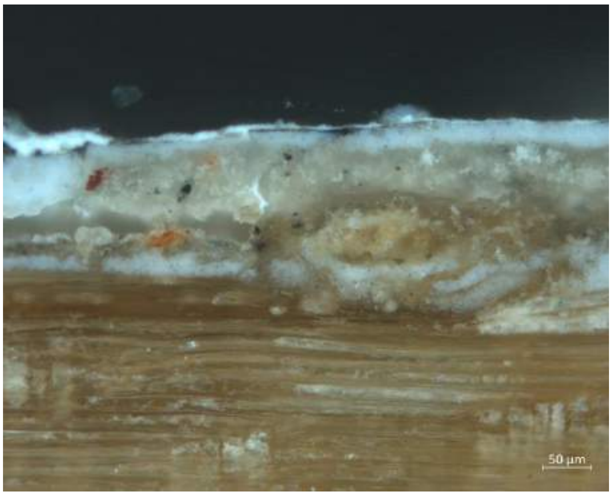
The original finish of the window consisted of a single white paint layer containing zinc white, lead white, little barium sulphate and little chalk. This is similar to the first paint layer on the window in the dining room.

The second finish was also applied as a single grey paint layer, containing zinc white, gypsum, and some fine red and blue pigment.

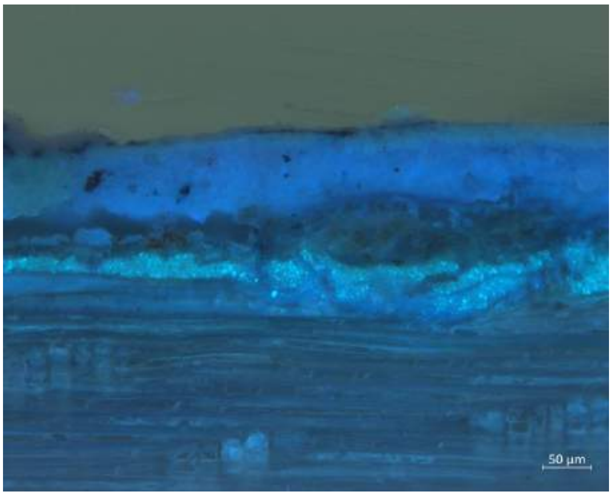
Finally, the window was overpainted with a white paint layer consisting of talc, titanium dioxide (rutile) and little quartz.

These three phases correspond with the three phases in sample 19-051-5 of the window in the dining room and sample 19-051-18 of another window in the bedroom.

Sample number 19-051-17 (MHM36) bedroom, 1st window west, outer window, interior side



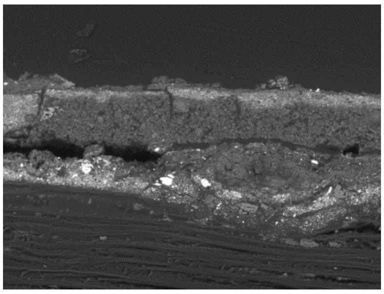
Microphotograph of the paint cross section under incident polarized light



Fluorescence microphotograph of the paint cross section (exitation filter BP365/12 nm; emission filter LP 397 nm)

SEM-EDX results

Layer 5: very thin white paint layer:	**Ti Si** Al Mg Ca (Zn)
Layer 4: white paint layer:	**Zn Ca S** Si Al
Layer 3: thick light grey layer:	**Ca**
Layer 2: yellowish filler or ground paint:	**S Ca** Zn Si Al (Fe)
Layer 1: greyish white paint layer:	**Zn** S Ca



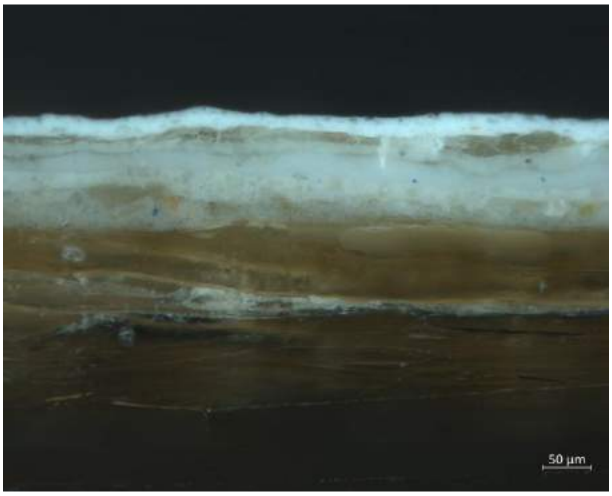
On the wood a damaged greyish white paint layer is present, consisting of zinc white and little gypsum. Similar paint layers are found in samples of the window in the dining room (sample 19-051-5) and the window in the bedroom (sample 19-05-16) as the first overpainting.

This was overpainted with a filler of gypsum, little zinc white and little ochre, a ground of chalk and a white paint layer containing zinc white, gypsum and aluminium silicate.

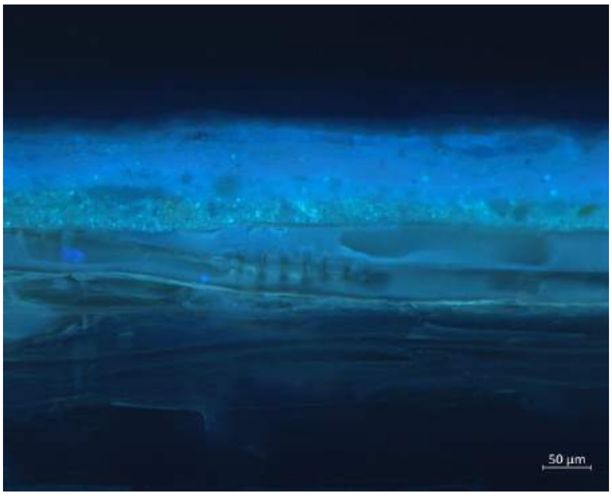
It was finally overpainted with a very thin white paint layer consisting of titanium dioxide, aluminium and magnesium silicates and little chalk.

Comparison with samples 19-051-5 and 19-051-16 indicates that the first finish from 1929 is missing in this sample.

Sample number 19-051-18 (MHM38) bedroom, 2nd window west, inner window, interior side



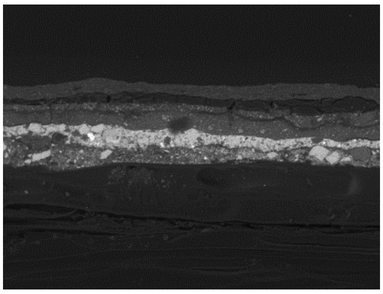
Microphotograph of the paint cross section under incident polarized light



Fluorescence microphotograph of the paint cross section (exitation filter BP365/12 nm; emission filter LP 397 nm)

SEM-EDX results

Layer 6: white paint layer:	**Ti** Ca Mg (Si) (Al)
Layer 5: transparent layer:	**C**
Layer 4: white paint layer:	**Zn Ca**
Layer 3: white paint layer:	**Zn**
Layer 2: white paint layer:	**S Pb** Ba Zn Si (Al)
Layer 1: white paint layer:	**Zn** Ca S (Ba) (Pb)
Layer 0: wood	



The window originally was painted white with a white preparation paint layer containing zinc white, gypsum, little barium sulphate and very little lead white, followed by a white paint layer (finish layer) consisting of lead white, barium sulphate, zinc white and little silicate filler.

This white finish was overpainted with a white paint layer, consisting of zinc white with a very small amount of blue pigment. The next paint layer, consisting of zinc white and chalk, is probably a next overpainting. It is covered by a transparent organic layer.

On this follows the final overpaint, consisting of a single white paint layer with titanium dioxide, dolomite and very little aluminium silicate.

These three phases correspond with the three phases in sample 19-051-5 of the window in the dining room and sample 19-051-16 of the window in the bedroom.

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[i] **APPENDIX**

Melnikov House Moscow_ Architectural Paint Research
an identification mission in the Shared Cultural Heritage Programme
'The Melnikov House, a building designed by architect Konstantin Melnikov in Moscow for himself and his family (1927-29), is an icon of the architectural avant-garde. The house was originally built as an experimental cylindrical house to test Konstatin Melnikov's very own concept for the mass construction of housing. The original layout, elegant spatial arrangement and ingenious engineering techniques have made this masterpiece world famous.
According to Melnikov, the essence of his house lies in its 'equivalence and equability of weight, light, air and heat'. Being of a unique architectural form, it still looks modern while retaining the authentic memorial atmosphere of the 20th century, thus reflecting the tragic life of this solo architect.' [Kuznetsov, Pavel, *The Melnikov House. Icon of the Avant-Garde, Family Home, Architecture Museum*, DOM publishers Berlin, 2017, cover text]
Tapani Mustonen , the Finish architect who restores the Melnikov house on the authority of the State Melnikovs Museum, figured out that colour and material research phases are among the key issues in the intended restoration process. For this reason the State Melnikov's Museum requested the assistance of Dr. ir. M.G. Polman expert on Architectural Paint Research (APR) at the Cultural Heritage Agency of the Netherlands (letter of request to be received).

Identification mission
Aim
The goal of the identification mission in January 2018 (5 days stay and travel, to be determined later in the period 24/01 till 02/02) is to identify the issues at stake and to define a research proposal, which may consist of a 'kleurinventarisatie', an inventory of the finishing layers of the building. The mission also aims at getting acquainted with the team and to discuss the project with the team. The Dutch embassy will be involved in the mission.
Outcome
The mission will produce a report, containing minutes of the mission, a research proposal, proposal for the involvement of RCE in the programme, facilities in Moscow , possible teamwork.
Scope of the foreseen programme
The foreseen programme offers various possibilities in the exchange of:
-knowledge on colours, materials and architecture of the Modern Movement/De Stijl, thus: continuation of the Programme *Erfgoed van de Moderne Tijd* (Heritage of the Modern Age)
-workshop on architectural paint research

> [The international network of architectural paint researchers does not include specialists from Russia (based on the APR conference in NYC, 2017). The Dutch APR has a high standard, it is the only country with an official study (University of Amsterdam, Conservation and restoration of Cultural Heritage, discipline: Historic Interiors)]

-knowledge on museum houses

> [Mariël Polman has been closely involved in the APR/maintenance of House Sonneveld Rotterdam, Studio House Theo van Doesburg Meudon (F), Van Doesburg Rinsemahuis Drachten]

-to define the Dutch colour/paint of the Modern Movement in relation to the Russian avant-garde and vice versa
-if possible: relate with the other Russian/Dutch projects
Draft programme of the mission
day 1:acquaintance with Pavel, Tapani, Mariël and Holger; introduction of the House; acquaintance with Dutch Embassy.
day 2-3: inventory of finishing layers in situ
day 4-5 : consult with Pavel, Tapani, Mariël and Holger/ completion of the inventory
Time:
field work: 40 hours
elaboration: 20 hours
Involved stakeholders of the mission
Mariel Polman: Architectural Paint Research Expert, Cultural Heritage Agency of the Netherlands, m.polman@cultureelerfgoed.nl
Tapani Mustonen: Restoration Architect:, arkkitehti SAFA , Helsinki (Fi); tapani.mustonen@arkkitehditmustonen.fi
Pavel Kuznetsov: the State Melnikovs Museum, Moscow; pavel.kuznetsov@muar.ru; p.v.kuznetsov@gmail.com
Holger de Kat: Restoration Architect , Leiden (NL), holger@edkarchitecten.nl
Ida de Kat, Dutch Embassy, Moscow; ida-de.kat@minbuza.nl
MP, Amsterdam, 22-12-2017

[ii] APPENDIX

The Agreement of the Commission

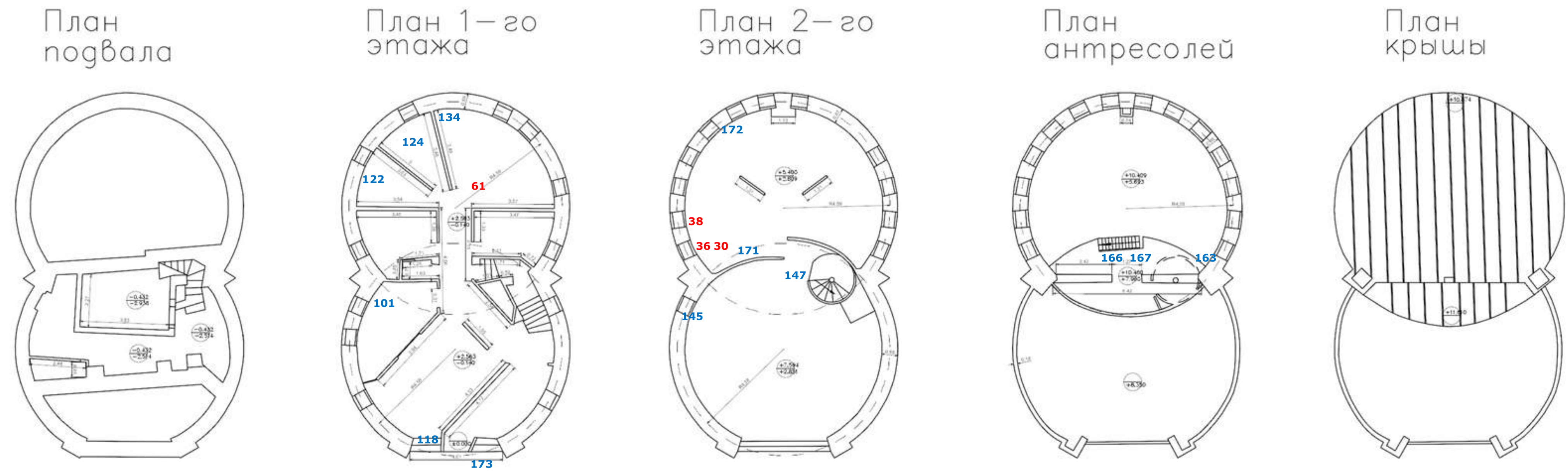
. Subject of the Agreement
1.1 Museum commissions and the Consultant undertakes to perform the work on consulting the Museum on colors and architectural paints within the framework of the grant agreement between the Museum and Getty Foundation #R-ORG-201735134 dated 14 June 2017 (hereinafter – Grant) for technical survey and preparation of a conservation plan for the Melnikov House (Moscow, Krivoarbatsky per., 10) including:

1.1.1 On-site research including sampling for:
- Microscopy
- Scanning Electron Microscopy Energy-Dispersive X-ray Spectroscopy (SEM-EDS) and Fourier Transform Infrared Spectrometry (FT-IR) 50-60 samples,
-Composition research binding medium (gas chromatography-mass spectroscopy GS-MS, 3-6 samples).
1.1.2 Archival research based on materials provided by Museum.
1.1.3 Research in the Laboratory in Amsterdam:
- Microscopy,
- Scanning Electron Microscopy Energy-Dispersive X-ray Spectroscopy (SEM-EDS) and Fourier Transform Infrared Spectrometrie (FT-IR) 10-15 samples.
1.1.4 Preparation of narrative report with description of research done and its results.
1.1.5 Recommendations for further research, including reconstruction of colors based on the analysis in the authentic pigments/ bindings and in records, implementation of conservation works and annexes containing technical results of analysis.

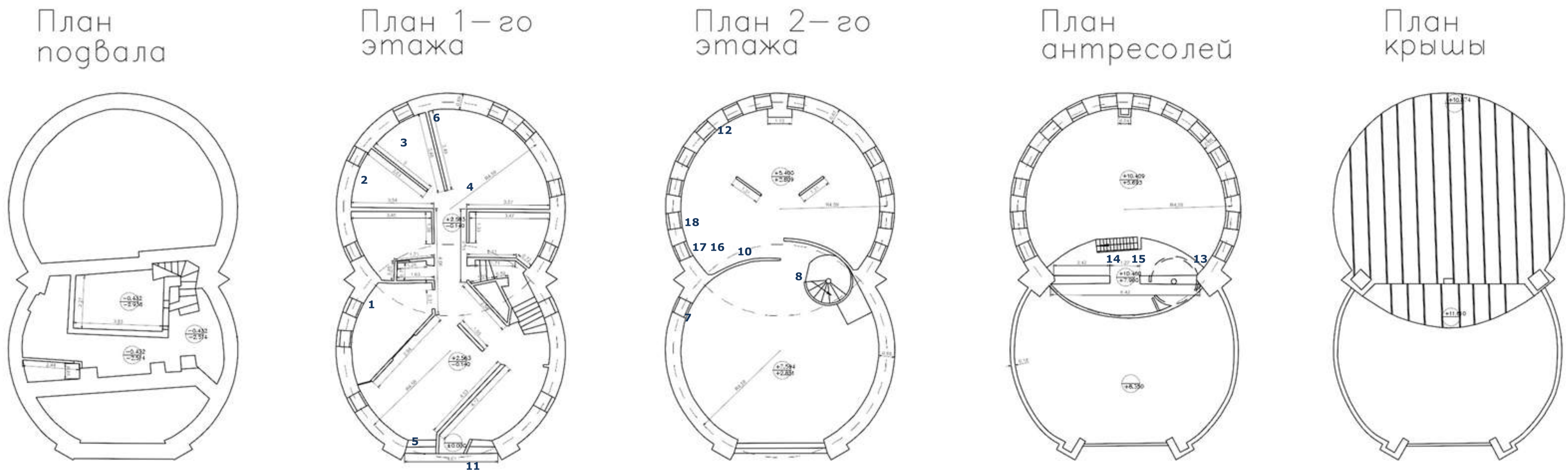
1.2 Starting date of this Agreement is
11 February 2019, finishing date is 15 April 2019.

1.3 The works listed in section 1.1 will be done by two experts from the Consultant staff: Maria Gabriella Polman and Luc Megens.

appendix



samples Melnikov House Moscow

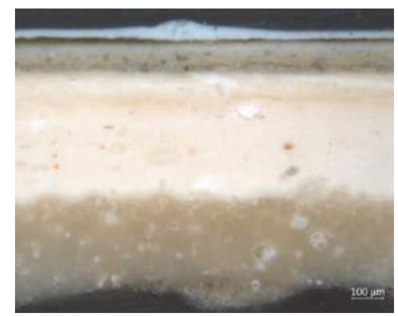


analysed samples Melnikov House Moscow **19-051-**

1st floor_kitchen_dado of the wall behind the stove

location MHM 101

sample MHM 101 _ 19-051-1



19-051-1
microphotograph of the paint cross section under incident polarized light

1st floor_kitchen_dado of the wall behind the stove , next step

location MHM 101

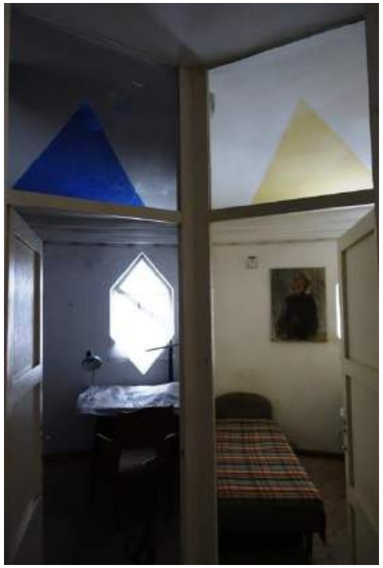
cross section 19-051-1

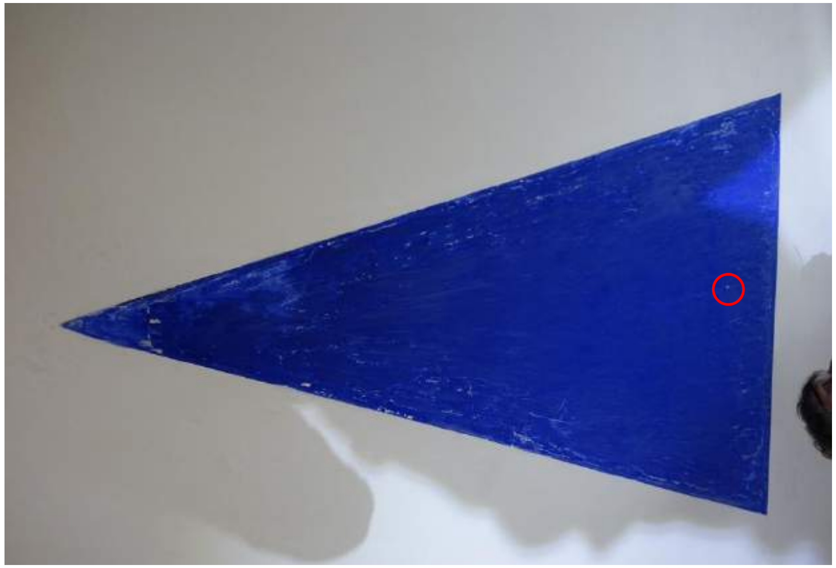
19-051-1 microphotograph of the paint cross section under incident polarized light

next step : to define the chronology of the top layers by relating the cross section with the traces in situ.

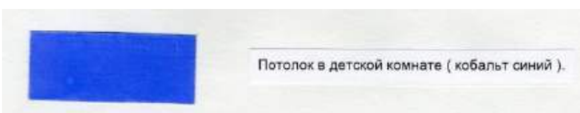
1st floor_boy's room, blue triangle on the ceiling

location MHM 122

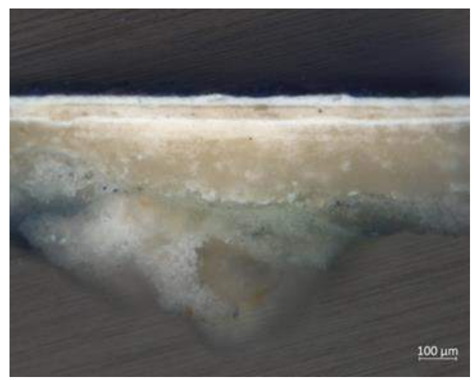




sample MHM 122 _ 19-051-2



research 1996: colour match of blue :
2 - ceiling in kid's room
(cobalt blue 1 part + chalk 0,5 part, #449)
Cobalt blue is not analysed in sample 19-051-2



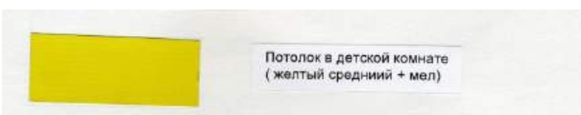
19-051-2a and 19-051-2b microphotographs of the paint cross sections under incident polarized light

1st floor_girl’s room_yellow triangle on the ceiling

situation

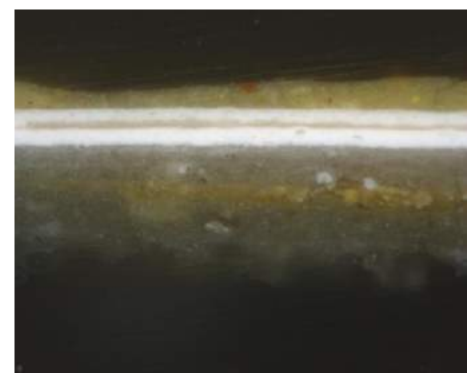
location MHM 124 (photo 2018)

sample MHM 124 _19-051-3



research 1996:
colour match of yellow :
1 - ceiling and wall in a kid’s room
(yellow medium 1 part + chalk 16 parts, #411)
This might be possible in cross section 19-051-3

1996: stratigraphy of the yellow triangle :
green and white layers underneath the yellow



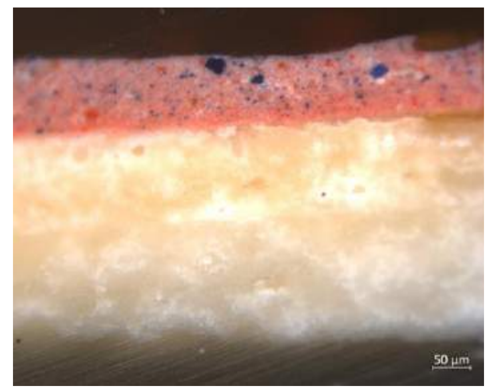
19-051-3 microphotograph of the paint cross section under incident polarized light

1st floor_dressing room, red surface on the ceiling

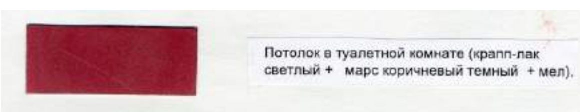
situation

location MHM 61

sample MHM 61_19-051-4



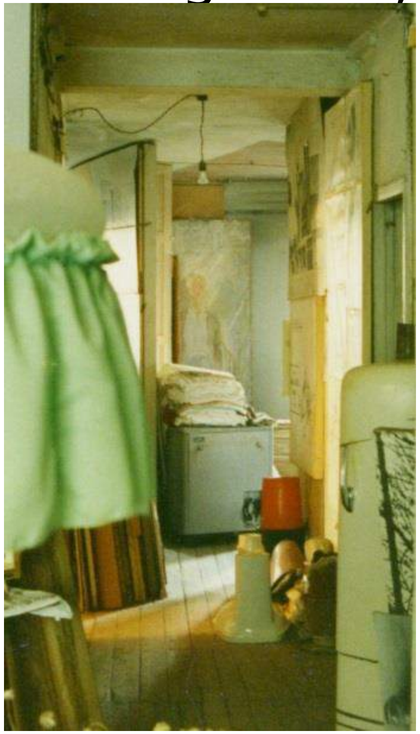
19-051-4 microphotograph of the paint cross section under incident polarized light



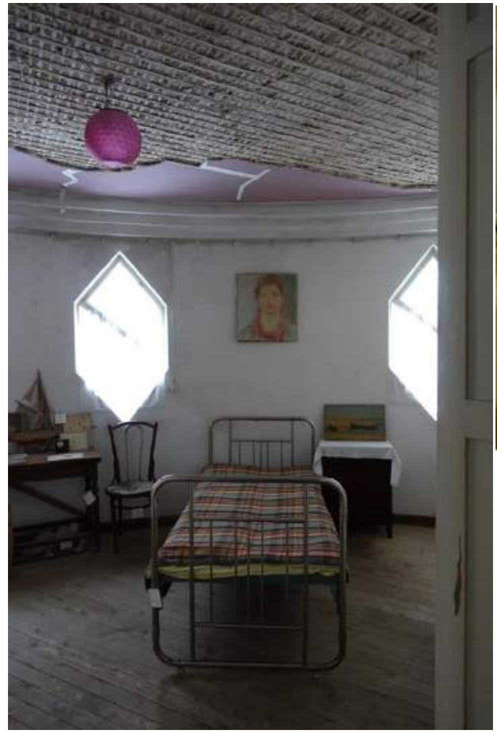
research 1996: colour match of red :
3 - ceiling in wardrobe/changing room
(krapp-lacque light 1 part + mars brown dark + chalk 3 parts, #380)

1st floor_dressing room, red surface on the ceiling, archives

2018



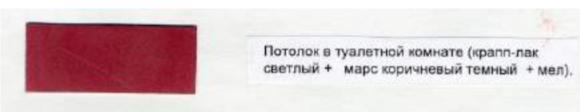
1996



2018

1996

1996

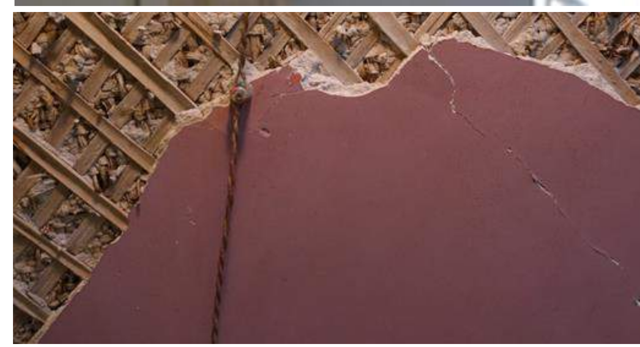


research 1996: colour match of red :
3 - ceiling in wardrobe/changing room
(krapp-lacque light 1 part + mars brown dark + chalk 3 parts, #380)

1996: stratigraphy of the red surface:
green en white layers underneath the red

2018,2019: completely reconstructed ceiling

1997



2018

1st floor_dining room, window frame of inner window, interior side

location MHM 118

sample MHM 118 _ 19-051-5

19-051-5 microphotograph of the paint cross section under incident polarized light

research 1996: situation :
white painted window interior

1st floor_dressing room, closet between dressing room and girl's room, right part

location MHM 134

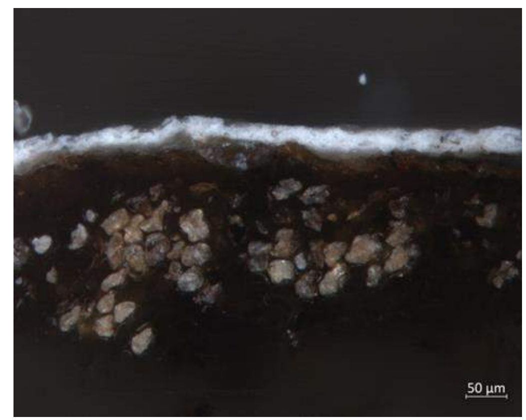
sample MHM 134 _ 19-051-6

19-051-6 microphotograph of the paint cross section under incident polarized light

2nd floor_living room, octagonal window, inner window, interior side

location MHM 145

sample MHM 145 _ 19-051-7



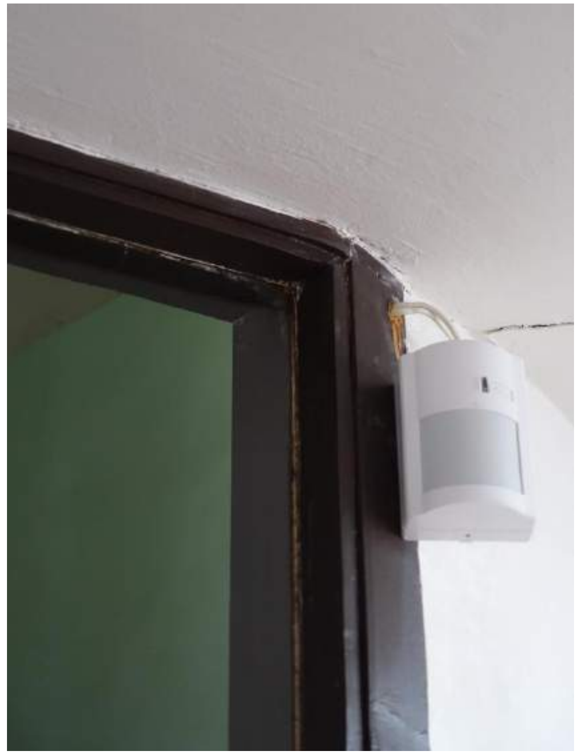
19-051-7 microphotograph of the paint cross section under incident polarized light

Question : does the octagonal inner window match with :
research 1996: colour match of brown : 10 - doors on the first floor, plinth on the ground floors, floors of mezzanine in studio. Oil-based (mars brown dark 3 parts + krapp-laque light 1 part, #367) ***?***

2nd floor_living room, doorframe to stairs

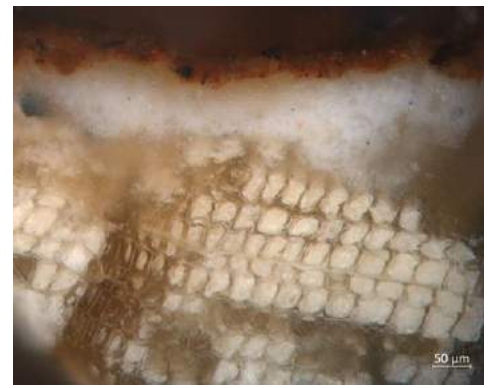
location MHM 147

sample MHM 147

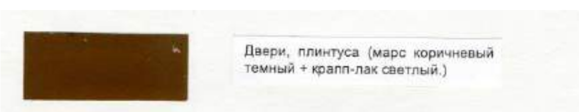


sample MHM 147_19-051-8

research 1996: situation



19-051-8 microphotograph of the paint cross section under incident polarized light



research 1996: colour match of brown :
10 - doors on the first floor, plinth on the ground floors, floors of mezzanine in studio. Oil-based
(mars brown dark 3 parts + krapp-laque light 1 part, #367)

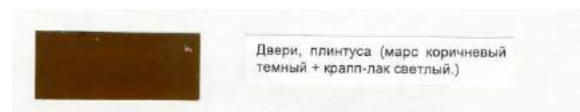
2nd floor_living room, doorframe to stairs, archives

painting Konstantin Melnikov 978 ©MH.archive

painting Konstantin Melnikov 1020 ©MH.archive

photo 1930 ©MH.archive

photo research 1996



research 1996: colour match of brown :
10 - doors on the first floor, plinth on the ground floors, floors of mezzanine in studio. Oil-based
(mars brown dark 3 parts + krapp-laque light 1 part, #367)

paining of the bedroom by Viktor Melnikov, golden finishing coat

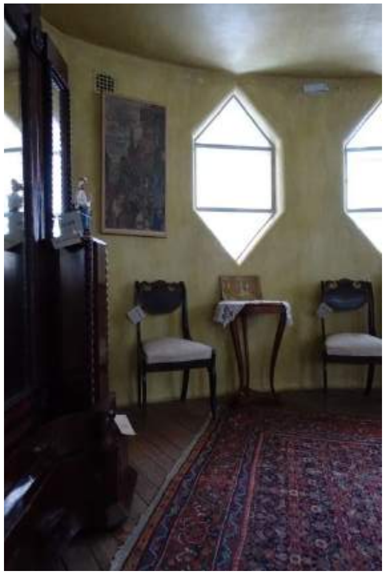
painting Viktor Melnikov 162

sample MHM 162 _ 19-051-9

19-051-9 microphotograph of the paint cross section under incident polarized light

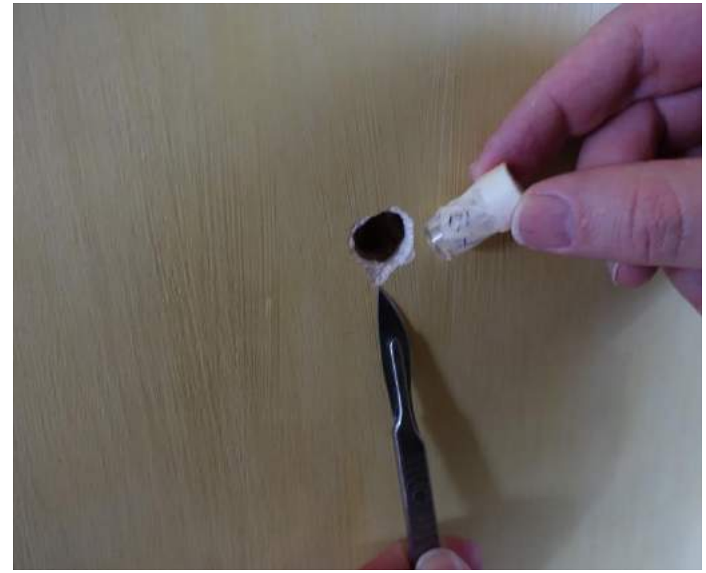
2nd floor_bedroom, golden wall, left from entrance, behind mirror

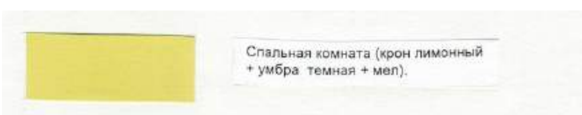
situation



location MHM 171

sample MHM 171 _ 19-051-10





research 1996: colour match of the ‘golden’ wall :
11 - bedroom
(chrome lemon 18 parts + umber dark 0,5 part + chalk 7 parts, #163).
'Italian stucco' with polishing of finishing layer with marble powder and wax

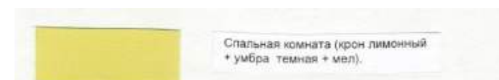
situation 1996: wall paper on ceiling and on the walls and top corner of the door

19-051-10 microphotograph of the paint cross section under incident polarized light

2nd floor_bedroom, golden wall, archives and observation

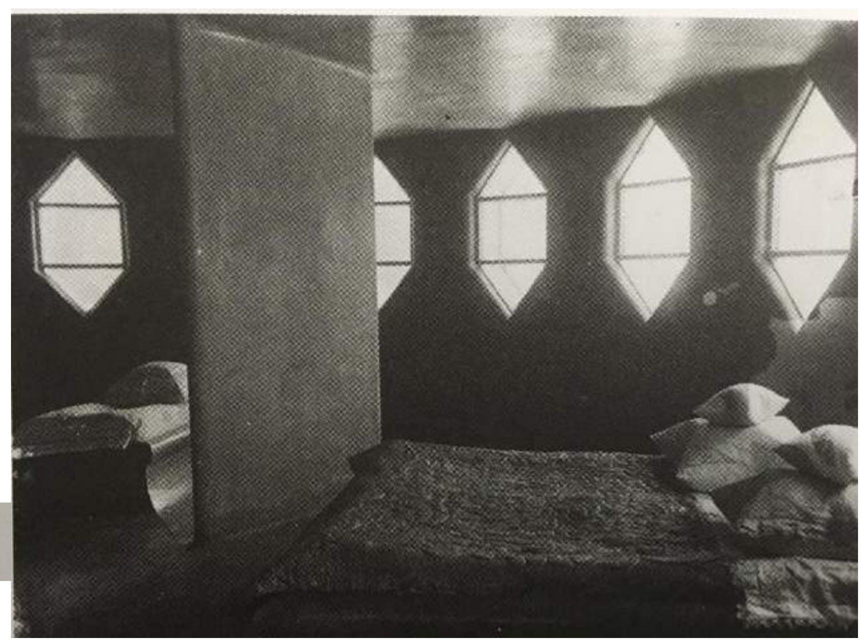
painting Viktor Melnikov 1930s
792 ©MH.archive
the shining of the finishing on the ceiling gets special attention in this painting

19-051-10 microphotograph of the paint cross section under incident polarized light : minimal yellow pigments



research 1996: colour match of the 'golden' wall: 11 – bedroom (chrome lemon 18 parts + umber dark 0,5 part + chalk 7 parts, #163). 'Italian stucco' with polishing of finishing layer with marble powder and wax

the pattern of the finishing on the ceiling has similarities to photo 1930s :



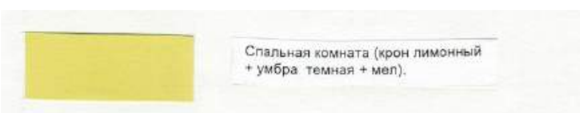
Bedroom interior. Early 1930s. Photo.
MH. Inv. 196/3/5, p. 1.

©MH.archive

research 1996: situation: wall paper on ceiling and on the walls and top corner of the door

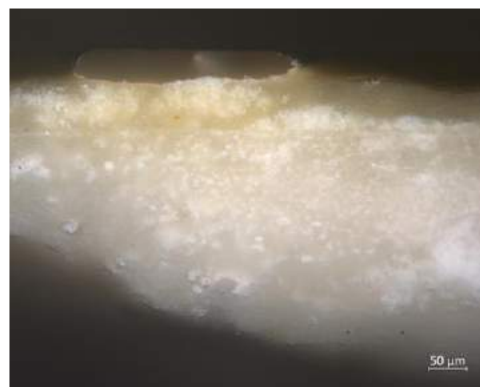
2nd floor_bedroom, golden wall, behind the sofa

location MHM 172



research 1996: colour match of the 'golden' wall : 11 - bedroom (chrome lemon 18 parts + umber dark 0,5 part + chalk 7 parts, #163).
'Italian stucco' with polishing of finishing layer with marble powder and wax

sample MHM 172 _ 19-051-12

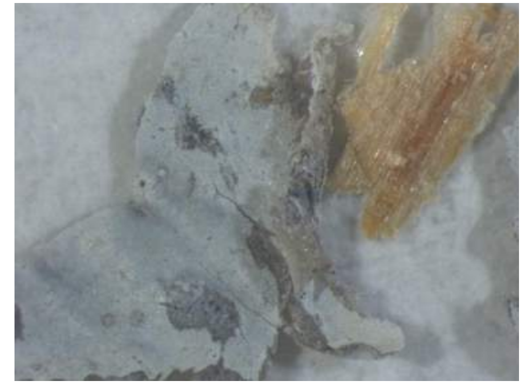


19-051-12 microphotograph of the paint cross section under incident polarized light

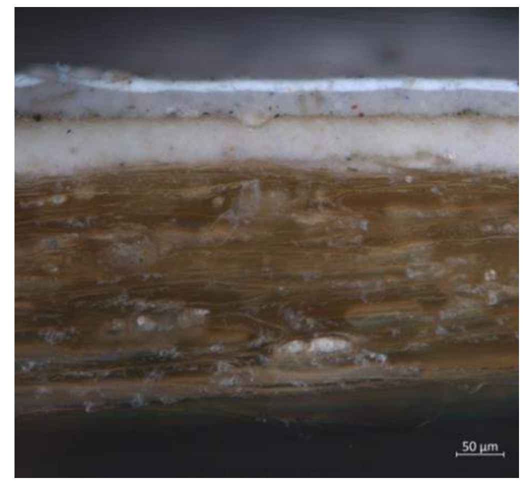
2nd floor_bedroom, first window west/from left, outer window, top window, interior side

location MHM 30

sample MHM 30 _ 19-051-16



2,5 x

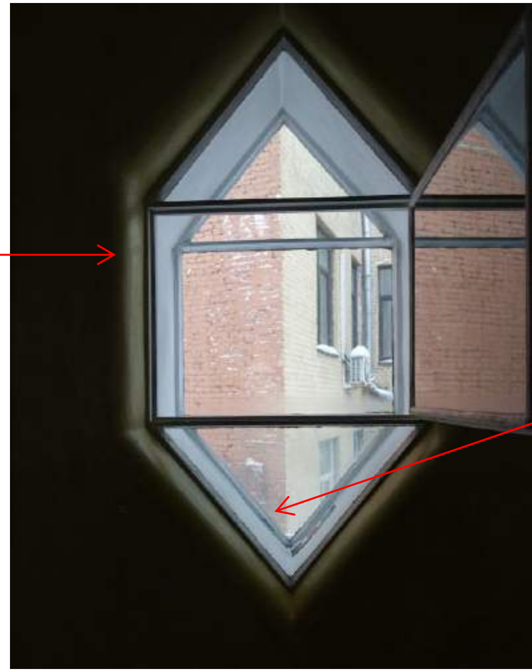


19-051-16 microphotograph of the paint cross section under incident polarized light

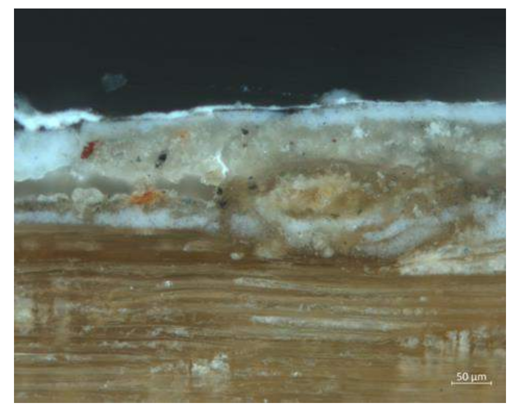
2nd floor_bedroom, first window west, outer window, interior side

location MHM 36

sample MHM 36 _ 19-051-17



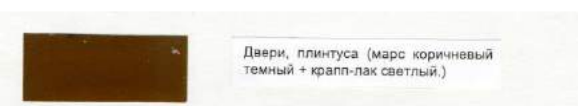
sample 1,5



19-051-17 microphotograph of the paint cross section under incident polarized light

exterior_window to the right of the entrance door

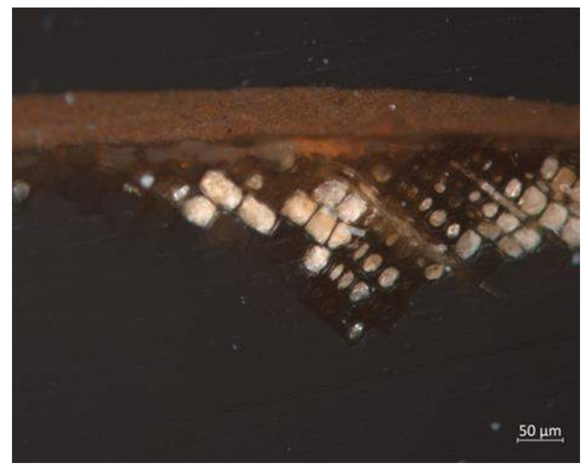
location MHM 173


Двери, плинтуса (марс коричневый темный + крапп-лак светлый.)

research 1996: colour match of brown : 10 - doors on the first floor, plinth on the ground floors, floors of mezzanine in studio. Oil-based (mars brown dark 3 parts + krapp-laque light 1 part, #367)

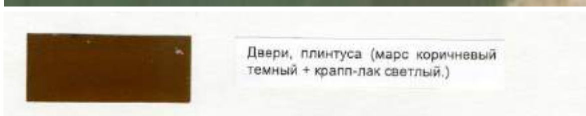
sample MHM 173 _ 19-051-11

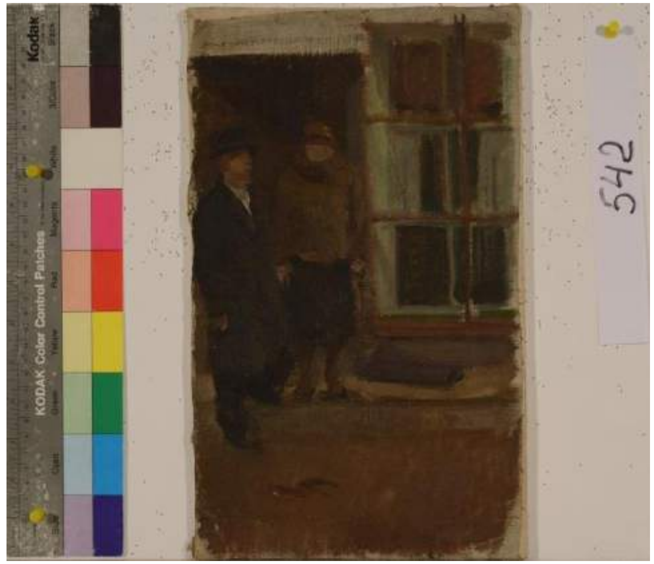
sample MHM 173



19-051-11 microphotograph of the paint cross section under incident polarized light

exterior_window to the right of the entrance door, archives





situation 1996 (photo from the dining room shows the brown colour of exterior window)
1996 colour sample
painting Viktor Melnikov 1939 , 542 ©MH.archive
painting Viktor Melnikov , 719 ©MH.archive
painting Viktor Melnikov 1936, 693 ©MH.archive

All sources show a brown finishing on the exterior windows, (outer window, exterior side).

2nd floor bedroom 2nd window from west, inner window, interior side

location MHM 38

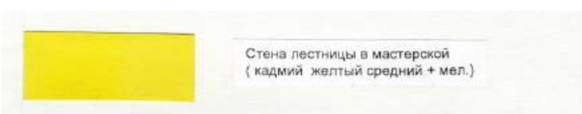
sample MHM 38 _ 19-051-18

19-051-12 microphotograph of the paint cross section under incident polarized light

3rd floor_studio, yellow cylindrical wall with green plaster under the paint layers

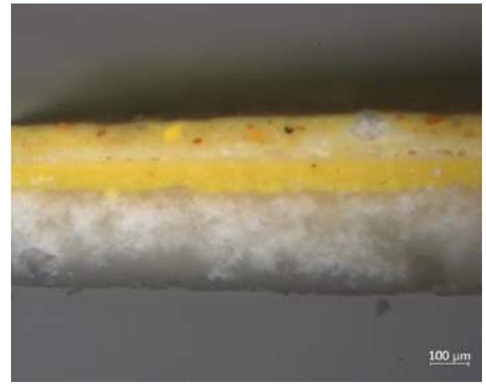
location MHM 163

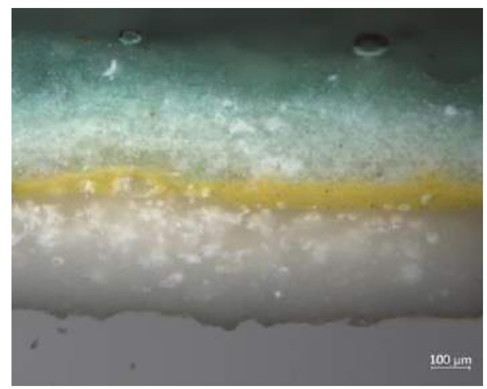
sample MHM 163 _



research 1996: colour match of the yellow wall :
12 - wall of the staircase in the studio.
(cadmium yellow medium 1 part + chalk 16 parts, #411)

sample 19-051-13





19-051-13 microphotographs of the paint cross sections under incident polarized light

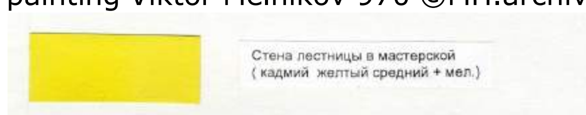
exposure of the overpainted yellow paint layer

3rd floor_studio, yellow cylinderical wall , archives

painting Viktor Melnikov 429 ©MH.archive

painting Viktor Melnikov 970 ©MH.archive

situation 1990 ©MH.archive



research 1996: colour match of the yellow wall :
12 - wall of the staircase in the studio.
(cadmium yellow medium 1 part + chalk 16 parts, #411)

research 1996: situation

3rd floor_studio, yellow balustrade of the entresol, middle post

location MHM 167

sample MHM 167

situation 1990 ©MH.archive

sample 19-051-15

research 1996 : situation

19-051-15 microphotograph of the paint cross section under incident polarized light

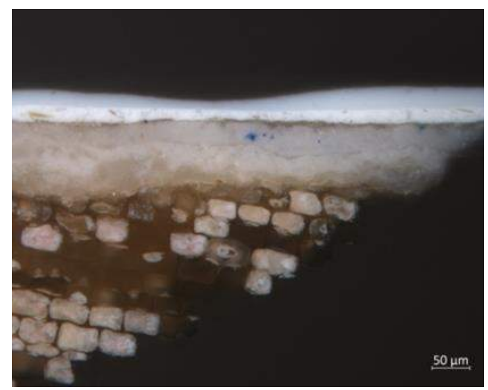
3rd floor_studio, white balustrade of the entresol, white vertical post

location MHM 166

sample MHM 166

sample 19-051-14

research 1996 :
situation



19-051-14
microphotograph of the paint cross section under incident polarized light