

Functional Villa Tugendhat and its Geological Subsoil - Design of a New Geotourism Place

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Abstract. Functionalist villa Tugendhat deserves to be one of the UNESCO heritage sites. The author of this building was a prominent German architect, Ludwig Mies van der Rohe, who accepted the contract from Greta and Fritz Tugendhat. From today's perspective, this building is one of the most important pre-war works of this architect. The 1928 architectural design was subsequently very quickly completed and the construction was completed in 1930. The Tugendhat family lived in a villa until 1938. During World War II it was confiscated by German occupation forces. At the end of the war, it was used by the Red Army and later served for the state. During this period, this building did not avoid warfare or later destruction of both the building and parts of the facility. The importance of this building was recognized in 1969, when the villa was placed on the State List of Cultural Monuments. In the 80's was the first major renovation of the building, which is often criticized. The second, last reconstruction took place in the years 2010 - 2012. During these reconnaissance works there were also old, temporarily calming landslides, which were subsequently solved. For this reason, the site is suitable for geotourism as an example of architectural monuments versus geological subsoil.

1. Introduction

The Czech Republic is one of the countries that have a rich history in many important historic buildings. In this country there are cities where there are important buildings that document their long and rich history. An example is the city of Prague, where monuments dating back to the early years of the building and development of this town are admired, containing an overview of individual styles, from Romanesque to modern. For this reason, many of these sites are already listed on the UNESCO cultural heritage list and others are still waiting for registration. The development of tourism has seen significant changes in recent years. Tourist clientele demands ever-new and unconventional forms of tourism, including geotourism. A classic tour of significant historical buildings is now expanding with other offers that are possible in the given locations. One option is also the focus on the inanimate nature, the subsoil of buildings, the material used for basic construction or decoration, and the like. Recently, intensive restoration work has also taken place, which is more complex than before. At these events, using new scientific and technical possibilities, there are problems that have been overlooked. Geological subsoil significantly affects the statics of some of these objects and can significantly



endanger these structures. An example is the collapsed walls of some buildings, such as Trenčín Castle in Slovakia. With similar problems at a smaller scale, Villa Tugendhat also struggled. On their walls, before the last reconstruction, it was possible to observe large cracks, which were a significant warning signal for the immediate commencement of major repairs and stabilization of the building. Although it is a building not so old, it can be a sample example of the effects of geological subsoil on the stability of buildings in the future.

2. Main features of functionalism

Modern architecture is a new construction style of the twentieth century that brings new insights, principles and patterns into architecture. The distinctive architectural style that we can associate with this style is functionalism [1], [2], [3], [5], [6], [14]. This direction has evolved from the 1920s to the 1950s. However, some of its main features are also used today. The main idea of this style is to respond to new times and to build purposeful buildings of simple shapes that do not contain unnecessary ornaments. There are structures with free ground plan and reinforced concrete frame structure. The buildings are open into a yard-free space and asymmetric. Typical is a flat roof, later with a slight incline and a smooth facade. Continuum windows are also popular. Buildings have a predefined function ("form follows function") and also respond to industry requirements. Also, the material used in their implementation is innovative and unconventional. New materials such as iron and concrete or fireclay bricks are used. Also, the interior equipment uses an unusual spectrum of materials such as linoleum, leatherette, chrome and nickel pipes or plastic. One of the greatest architects and urban planners of the 20th century, Le Corbusier has set these "Five Points of Modern Architecture":

- 1) Columns: Build houses on pillars, releasing the ground floor for greenery and free movement.
- 2) Roof gardens: The technique of flat roofs allows building on the roofs of the garden. They replace the greenery that the house took away from.
- 3) Free ground plan: the columns carry the forces of all the floors, which allows free space partitioning with non-load-bearing partitions.
- 4) Continuum windows: The column system allows you to lead long windows between columns.
- 5) Free Facade: The console-raised ceilings release the front for a totally free solution of windows and façade

Czechoslovakia, together with Germany and Holland, has been among the main centers of functionalist architecture since the beginning. This direction was also developed in Russia. The 30's also bring greater exterior and interior variations and projections of historicism. Outside Europe, this style has begun to become more and more popular since the 40's. It is expanding to different parts of the world, such as North Africa, North and South America, Japan, India. This development also had the merit of architects who are already in the 30s, unfavourable for this direction, they left Europe and headed mainly to the US (among them Ludwig Mies van der Rohe), where he further developed. In Czechoslovakia, this direction was strongly applied in the inter-war period. The openness of the state at that time allowed us to find more objects from the major European architects of the time. In addition to the Tugendhat Villa by Ludwig Mies van der Rohe, we can admire Müller's villa in Prague at Ořechovka by Adolf Loos or the Palikova Villa from Marta Stam in Prague - Dejvice. The construction and architecture of Zlín was also very excited by Le Corbusier, who also actively participated in the plans for its construction.

3. Functionalism In Brno Architecture

The first Czechoslovak Republic recorded very rapid economic development and construction. Right after the establishment of this state entity, Brno became the second largest city. Its economic, cultural and political importance has also accelerated construction activities. The beginnings of the development of functionalism coincidentally overlap with the modern building development of this city. Brno is therefore rightly ranked among the leading centres of Central European functionalism. Up to now we can admire more than 70 functionalist buildings for different purposes. In addition to residential houses, family houses and villas, we find many other purpose-built buildings. Among them we can include the Brno Exhibition Center, school buildings, offices, sacral monuments, cafes and the like. Among the architects we find many important personalities, such as: Otto Eisler, Bohuslav Fuchs, Vladimír Karfík, Josef Kranz, Jan Visek, Ernst Wiesner and others. An important functionalist monument is the exhibition center. Although the original plans for its construction fall into the Austro-Hungarian Empire, its construction began only in 1927. On the occasion of the 10th anniversary of the Czechoslovak Republic, the first event "Exhibition of Contemporary Culture in Czechoslovakia" took place here. More than ten architects participated in the pavilions, including Josef Kalousek, Emil Kralík, Bohuslav Fuchs, Jaroslav Valenty and others. Part of the exhibition was colony The New House Colony on the slope above the exhibition centre, the first exhibition of modern living in the Czech Republic.

4. Villa Tugendhat

Of the many functionalist buildings that we can find in Brno today, this villa (Fig. 1, Fig. 2) represents an important architectural monument of world significance. The fact that this building was added to the UNESCO World Heritage List at the 25th meeting of the World Heritage Committee in Helsinki is also worth mentioning. The villa is located in the city of Brno-sever, Černopolní 45. The villa also includes a garden. This building was funded and donated to Alfred Löw-Beer's wedding gift by her daughter Greta Tugendhat and her husband Fritz Tugendhat. The architectural design was taken by the renowned German architect Ludwig Mies van der Rohe, whose work Greta Tugendhat met during her stay in Germany. In September 1928, the architect invited the Tugendhat's husband to Brno and was enchanted by a building plot overlooking the city's historical panorama. For this reason, he accepted the contract and, in the same year, designed this building.



Figure 1. Villa Tugendhat from the backside



Figure 2. Villa Tugendhat from the side

The original idea of the husband was to have a small house of five rooms. However, the architectural plan is excited and therefore finally agreed to build a villa in this form. The construction was carried out from June 1929 to December 1930. The general contractor was Mořice and Arthur Eisler from Brno, and many domestic and foreign companies participated in the construction. This building has become exceptional for several reasons. The main thing was that the author of the project, Ludwig Mies van der Rohe, was given the promise of complete freedom without any, especially financial constraints. This fact has also been reflected in the use of modern, costly, unique technologies and materials. Overall, therefore, the cost of construction, equipment and gardens reached 5 million crowns. For comparison, at that time, this price would cover the construction of three dozen ordinary houses. Although the villa on the street looks like a one-storey ground floor building, it is made up of three floors. Already entering the villa is interesting by being placed on the top floor. On the top floor, beside the reception hall, separate bedrooms of the couple, two children's rooms, a room for the nursing staff and social facilities, there is also a large terrace, an apartment manager and a garage for two cars. The middle floor represents a residential and representative part. For the sake of clarity, the cost of a 7 cm thick Moroccan onyx dividing the living space from the workplace to a high 200,000 crowns at that time. Another addition is the glass wall separating the winter garden with its own climate. The front of the room is glazed, containing seven dimensional boards (5 x 3.5 m) made of very clear glass. In two of them, it was possible to move the electric motors and slide them all under the floor. This has linked the interior of the building with the garden. The lower floor served for technical facilities (air conditioning, boiler room, engine room, laundry room, photo chamber, room for fur coats) and servants' premises. The technical point of interest is also the heating of the middle floor, which was very progressive at that time. If the lower and upper floors were radiated by radiators, the middle floor was heated by hot air using a sophisticated device that cleansed and flavoured the air.

The family in the house lived with three children until May 1938. The Jewish origin of the family, its activities and the oncoming war forced the family to emigrate first to Switzerland, later to Venezuela. Already at the beginning of October 1939 the house was confiscated by the Gestapo. Subsequent construction works and modifications began with slow devastation. Already in the following year, according to the testimony, there was no bar in the Makassar eben, and a large part of the furniture was missing. In early 1942, the house became the property of the German Empire and moved into it by Walter Messerschmidt, who also had an office here. At his command, several building modifications were made. Destruction was completed at the end of the war by pressure waves during the bombing of the city, when the glazed walls were destroyed, as well as by the cavalry section of Marshal Malinovsky. At this time, the common room even served as a stable for horses, furniture remains served for heating, the air conditioning technology and window-opening machines disappeared. Only an onyx wall and a built-in library were preserved. After the war, a private dance school was housed in the middle of 1950. In the same year, the villa became the property of the state and a rehabilitation center for children was established there. This monument of modern architecture was written on the 6th December 1969 in the State List of Cultural Monuments. In the years 1981-1985 the first major reconstruction was carried out. This reconstruction still has its critics as well as advocates. In 1992 there was talks on the division of the then Czechoslovakia. In 1994, the Brno City Museum was rebuilt, which subsequently made it available to the public. In the years 2010 - 2012, the second major reconstruction took place. Earlier efforts, which began in 2004, have been interrupted due to contestation of the competition, and also by the Tugendhat family's attempt to get the property back into their possession. This reconstruction was very thorough, and besides building structures, it also focused on engineering networks, technical equipment and garden revitalization. It was also a complex procedure to ensure the stability of the house. From a geological point of view, the site is affected by old landslides. The reconnaissance work in the villa and the surrounding area has shown the occurrence of temporarily calming landslides. In 2012, stabilization work, which has a preventive character over several decades, has been completed. In order to ensure the stability of the villa, the original way of settling in the wells was used, when the unsatisfactory old heels were replaced by the new wells on which the new beads were laid. These were then coupled using base belts with a villa. The results of the overall reconstruction are very perfect. It was based on the original preserved documentation and was dealt with every detail. The villa was also complemented by the original curved wall of Makassar eben, which was accidentally discovered in another building in Brno. Today's construction, together with the German pavilion at the EXPO exhibition in Barcelona in 1929, is one of the most important works of architect Ludwig Mies van der Rohe in his pre-war era [7], [8], [9], [12], [13], [15]. Unfortunately, many of his works in Europe are no longer present, they have been irreversibly destroyed.

5. Conclusions

Villa Tugendhat is rightly among the top works of modern architecture. Unfortunately, the original purpose served less than 8 years. Subsequent changes of owners and users, including the geological subsoil, have been significantly signed in the years to come. The emergency situation before the second reconstruction showed many shortcomings, which necessarily had to be solved immediately. The second, detailed reconstruction not only stabilized the building on a slope, it reconstructed the interior and exterior, but also saved the discovered, preserved fragments from the original materials used. The villa has become unique in its time for many reasons. It offered a habitable uninterrupted space that could be interconnected with the surrounding nature in the garden using sliding windows. Another novelty was the steel skeleton that formed the building's supporting system. The riveted columns, the cross section in the living rooms were covered with chromium sheet. Today the monument serves as a tourist object, which can also be used for the untraditional forms of tourism, which has been given increasing attention in recent years [4], [10], [11]. In terms of geotourism, the villa itself and its subsoil can provide a demonstration for engineering geologists regarding the redevelopment of monuments on unstable subsoil. At the same time, the use of the mineral resources used in the construction of this villa (classic travertine, onyx, cement mixtures, etc.) can be demonstrated here.

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