Lake and Modern Architecture: Drought in Switzerland, Pile Dwellings, and Pilotis

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Abstract
In 1854, Switzerland suffered from severe drought. Lake Zurich's water level was extremely low, and the lakebed, which is normally hidden under the water, was visible. These circumstances enabled the discovery of countless piles situated at the bottom of Lake Zurich. A study revealed that in the prehistoric Alps, there were pile dwelling settlements on the lake. Towards the end of the 19th century, when the modern architects were mere children, estimated restoration drawings of the pile dwellings could be found in Swiss elementary school textbooks. Therefore, this study clarifies the influence of the discovery of prehistoric pile dwellings on the architectural works of the modern Swiss architects Le Corbusier (1887–1965) and Hannes Meyer (1889–1954). This study used published documents as research material, and it revealed the following. First, Le Corbusier and Hannes Meyer designed piloti-style buildings on the shores of Lake Zurich for the League of Nations competition project (1927). Second, the term 'modern pile dwellings' appears in the design concept of Hannes Meyer's ADGB Trade Union School (1928–1930). In the execution plan (May 1930), the buildings maintained a certain level against the lake's water surface; hence, the term 'pile dwellings' was used in the concept. Third, the area around Lake Garda is particularly important with regard to pile dwellings in Italy. Since the Bauhaus student Pius Pahl (1909–2003) voluntarily selected Lake Garda for his diploma project (1932–33) and designed a house with pilotis on the lakeside, it is not a stretch to think that Pahl knew of the pile dwellings when designing the house. This study clearly reveals that the drought and the subsequent discovery of the pile dwellings influenced the use of lakeside pilotis in the designs of the two modern Swiss architects in the 1920s.

Keywords: *Modern Swiss Architect; Pile Dwelling; Piloti; Le Corbusier; Hannes Meyer*

1. Introduction
1-1. Background, Aim, Method, and Materials
It is widely known that modern architecture built on lakesides emphasizes the view (e.g., Villa 'Le Lac': 1923 by Le Corbusier; Lemke House: 1932–33 by Mies van der Rohe). However, it is not widely known that a more essential change occurred slowly from the middle of the 19th century to the first half of the 20th century in considering the relationship between lakes and modern architecture in Europe. At that time, the key words were 'pile' or 'piloti.'

The climate of 1854 triggered this change. In 1854, Switzerland suffered from severe drought. Lake Zurich's water level was extremely low, and the lakebed, which is normally hidden under the water, was visible. This enabled the discovery of countless piles situated at the bottom of Lake Zurich. A study revealed that in the prehistoric Alps, there were pile dwelling settlements on the lake. The discovery became a symbol of the roots of Switzerland, whose constitution and

democracy were established in 1848, and federal power was strengthened. Towards the end of the 19th century, when the modern architects were still children, estimated restoration drawings of the pile dwellings could be found in Swiss elementary school textbooks. Moreover, from the fall of 1920 to the spring of 1921, the weather in Central Europe was remarkably dry. In Central Switzerland, there had been little rain for six months, and the water levels of the lakes had fallen significantly.[1] This phenomenon led to a new discovery in the study of pile dwellings. Because the water level of the lake changed significantly in a short period, the possibility that the pile dwellings were not on the lake but on the lakeside was suggested.

Adolf Max Vogt (1996), an architectural historian at ETH Zurich, discussed the influence of Swiss vernacular architecture on Le Corbusier, an architect from the mountainous town of La Chaux-de-Fonds by Lake Zurich.[2] Vogt specifically discussed the influence of pile dwellings on one of the five points of modern architecture, pilotis. Tomita (2018) also discussed the influence of pile dwellings in a representative work on the architect Hannes Meyer from Basel, Switzerland, who also served as the second principal of the Bauhaus school.[3]

Therefore, based on previous studies, this study clarifies the influence of the discovery of prehistoric pile dwellings on the architectural works of the modern Swiss architects Le Corbusier (1887–1965), Hannes Meyer (1889–1954), and Bauhaus student Pius Pahl (1909–2003). In terms of methodology, in Section 2, we analyze the piloti style found in the 'League of Nations' competition plans (1927) by Corbusier and Meyer. In Section 3, we clarify the concrete influence of pile dwellings during the design process of Meyer's ADGB Trade Union School (1928–1930), and in Section 4, we focus on the 'House on Lake Garda' project (1932–33) by Bauhaus student Pius Pahl, who was influenced by Le Corbusier and Meyer. This study used published documents as research material.

1-2. Outline of the Theoretical History of Pile Dwellings in Archeology

Before proceeding to the discussion, we would like to summarize the outline of the theoretical history of pile dwellings in archeology based on the thesis by Francesco Menotti.[4] The main issue in research on pile dwellings is regarding their location. Three primary theories can be found in this regard: (a) in relatively deeper parts of a lake, (b) shallow beaches where there was water when the water level was high and land when the water level was low, and (c) on the shores of a lake. The first was Ferdinand Keller's theory in 1854, the second, Hans Reinerth's in 1921, and the third was Oscar Paret's theory, proposed in 1942.

Based on the results of academic considerations, pile dwellings were reconstructed in museums. Immediately after the 1854 survey, a two-dimensional picture was presented as a reconstruction by Keller (Figure 1).[5] These images were inspired by pile dwellings in the pacific region. Full-scale reconstructions then began in various places: from 1888–1890 at Schönenwerd in Switzerland, in 1909 at Kammer am Attersee in Austria, in 1919 at Riedschachen in Germany, in 1921 at Unteruhldingen in Germany, and so forth.[6] Thus, the increased research on pile dwellings approximately coincided with the development of modern architecture in Europe.

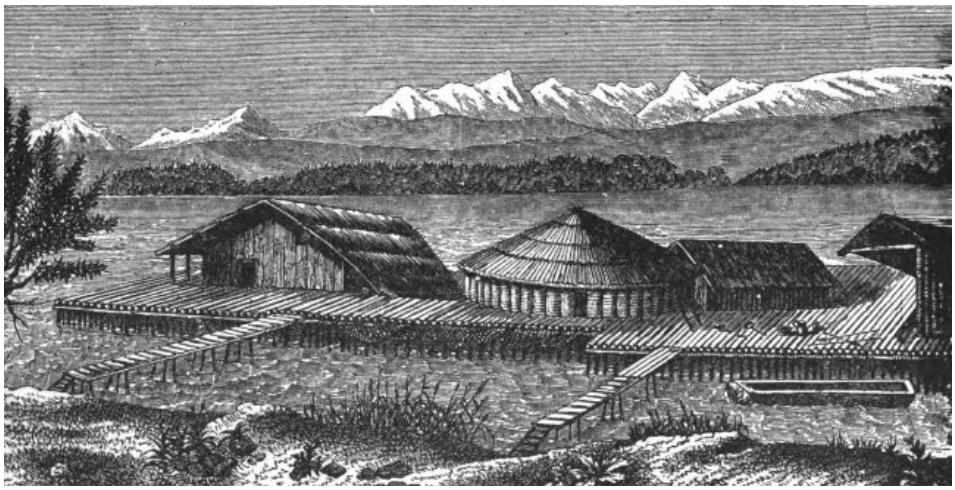

Figure 1: Ancient Lake-Dwellers' Village in Switzerland

2. Le Corbusier and Hannes Meyer's Piloti style in the 'League of Nations' Competition Project (1927)

Le Corbusier and Hannes Meyer designed piloti-style buildings on the shores of Lake Zurich for the 'League of Nations' competition project (1927). Pilotis are one of the most important features of modern architecture. The concept of the piloti was famously originally presented by Le Corbusier as one of the 'five points of modern architecture' (1927). The design itself, however, which lifts up the building and opens up the ground as a garden, can already be seen in Le Corbusier's 'Maisons Citrohan' project (1920‑1922).[7]

It is interesting that two modern Swiss architects who proposed using pilotis for traffic routes won the 'League of Nations' competition, a competition that received many proposals. Le Corbusier and Meyer's proposals for the use of pilotis in the competition were as follows: Le Corbusier opened the ground floor of the parliament building and the secretariat building to the traffic using pilotis, while Meyer lifted the entire parliament building with pilotis and opened up the entire ground floor as a traffic lane. The site of the 'League of Nations' competition gently sloped toward the lake, facing Lake Zurich. Therefore, the two architects opened up the ground floor using pilotis in order to handle the slope.

Architectural historian Kenneth Frampton (2002) focused on the commonality of the use of pilotis in Le Corbusier and Meyer's proposals: 'Both projects are partially lifted off the site on a system of pilotis, accommodating cars under their elevated sections in much the same manner as pile dwellings accommodate boats.'[8] Frampton's theory later evolved to recognize the difference between the two transport systems, and the pile dwellings metaphor was not used again. However, it is worth noting that Frampton took up the proposals of the two Swiss architects and explained the common proposed use of pilotis using the metaphor of pile dwellings. This is likely due to the Le Corbusier theory by Vogt (1996), introduced in Section 1, and an attempt to expand it to the Meyer proposal. Therefore, Section 3 focuses on Meyer's ADGB Trade Union School.

3. Hannes Meyer's 'Modern Pile Dwellings' in the ADGB Trade Union School (1928–1930)

In the design concept for the execution plan of the ADGB Trade Union School (1928–1930), Meyer described the teachers' houses, built using pilotis and facing a small lake in a pine forest, as 'modern pile dwellings.' In fact, in the design process of the ADGB Trade Union School, there

were three proposals, and the design of the teachers' houses changed.[9] Therefore, focusing on the 'pile dwelling' concept, we analyzed all three stages of the design process of the teachers' houses and the three different kinds of design concepts.

As mentioned, there were three plans: a competition plan (drawn up on August 16, 1928), an architectural application plan (drawn up on August 16, 1928), and an execution plan (drawn up on May 31, 1930). In the design process, the design of the teachers' houses changed significantly. In the competition plan, the buildings were arranged along the slope of the site and no pilotis were used. In the architectural application, however, pilotis appeared on the lakeside. As such, pilotis were adopted for the first time in architectural applications. Finally, in the execution plan, the buildings were changed to the same level horizontally as the prehistoric pile dwellings.

Regarding the design concept, there were also three versions of the text: the competition version (1928), the draft of the explanatory manuscript for the execution plan (no date), and the explanatory manuscript for the execution plan (1930).

Astonishingly, there were no descriptions of the teachers' houses in the concept of the competition plan. This is proof that the design of the teachers' houses was not emphasized in the competition plan. In the draft of the explanatory manuscript for the execution plan, the teachers' houses were described using the words 'pile dwelling': 'In contrast, the small pile dwellings of the teachers' houses, in their different forms, fulfill the special requirements of the teacher families living in it.' (*Die kleinen Pfahlbauten der Lehrerwohnhäuser erfüllen dagegen in ihrer andersartigen Gestalt die besonderen Anforderungen der in ihr ständig hausenden Lehrerfamilien.*)[10] However, the phrase occurs only here, and there is no concrete explanation for it.

In the explanatory manuscript for the execution plan (1930), the relationship between the pilotis and the landscape as well as life on the site was finally explained concretely: 'The landscape came right under the teachers' zigzagged houses and these modern pile dwellers could step down from inside the house and into their covered portion of the garden.' (*Ja, beim Zickzackbau der Lehrerhäuser dehnt sich die Landschaft bis unter die Häuser, und der moderne Pfahlbauer steigt abwärts im Hausinnern in seinen überdeckten Gartenteil.*)[11]

As mentioned above, in Hannes Meyer's ADGB Trade Union School (1928–1930), the term 'modern pile dwellings' clearly appeared in the design concept. However, in the competition plan (April 1928), the phrase was not used, since the levels of the buildings varied based on slope and elevation. In the execution plan (May 1930) however, it was changed so that the buildings maintained a certain level against the lake's surface; hence, the term 'pile dwellings' was used in the concept.

4. Bauhaus Student Pius Pahl's 'House on Lake Garda' Project (1932–33)

Pius Pahl was at the Bauhaus from 1930 to 1933. At the Bauhaus, Pahl designed various types of architecture. In particular, we can confirm his excellent design in the work of the courthouse in Mies's class, and a detached house in Hilberseimer's class. However, Pahl suddenly designed a house with pilotis on a site next to Lake Garda in northern Italy for his diploma project, namely, the 'House on Lake Garda' project (1932–33, Figure 2).[12]

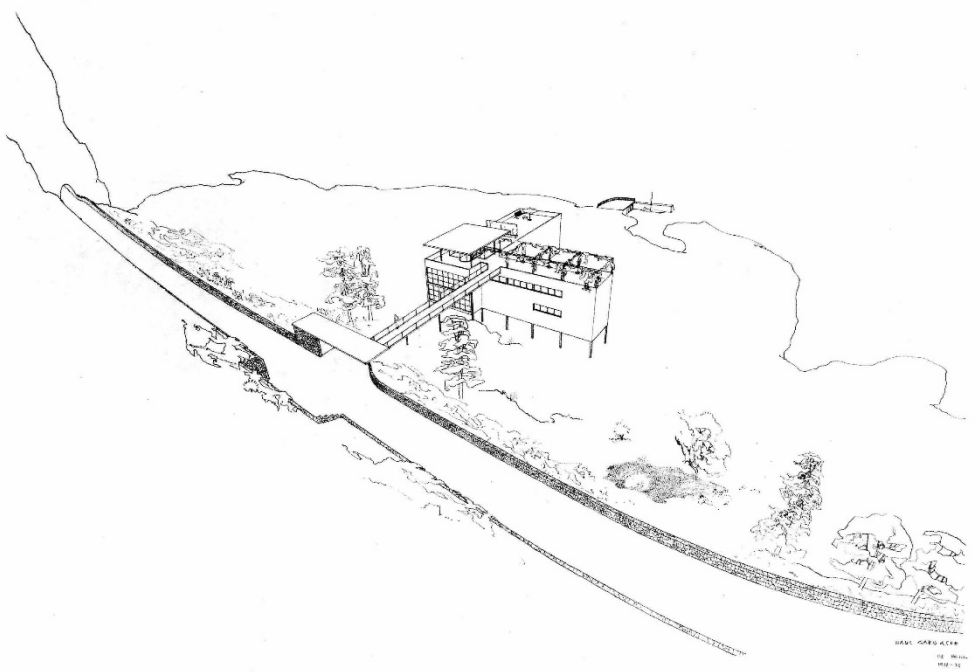

Figure 2: Pius Pahl's 'House on Lake Garda' project (1932–33). Aerial view from the Northwest

Architectural historian Norbert Korrek (1995) pointed out that the project was influenced by Le Corbusier and Mies.[13] For the living space, a space without a partition wall, like that of Mies, was proposed. On the site located on the shores of Lake Garda, the residential space was completely lifted by pilotis. Residents accessed the building from the roof, which was at the same level as the road. Korrek, however, does not consider the relationship between this residence and pile dwellings. Thus, we considered its relationship to pile dwellings based on drawings.

The area around Lake Garda is particularly important with regard to pile dwellings in Italy, since it has many remains of pile dwellings. Moving a little from the northern end of Lake Garda, there is Lake Tenno, where there are still piles. Since Pahl voluntarily selected this area for his diploma project and designed a house with pilotis on the lakeside, Pahl knew of the pile dwellings when designing the house. In addition to the relationship between the site and the piloti-style house, the influence of the pile dwellings through Meyer's ADGB Trade Union School, as mentioned in Section 3, cannot be denied. Pahl studied at the Bauhaus from the winter semester of 1930, when Mies became the president, and did not receive Meyer's architectural education. However, he likely knew of the design of the ADGB Trade Union School, which was completed in May 1930.

5. Conclusion

This study reveals that the drought of 1854 and the subsequent discovery of pile dwellings influenced the designs with lakeside pilotis of two modern Swiss architects in the 1920s and a Bauhaus student in the 1930s. In addition, some works by the ABC group (a Swiss and Dutch architects' group from the 1920s to which Meyer belonged) show piloti-style architecture near rivers and lakes. Some descriptions of pile dwellings can be found in urban planning and urban history research after World War II. Ludwig Hilberseimer, who was in charge of the urban planning classes at the Bauhaus, published 'The Nature of Cities' (1955) and described pile dwellings as one of the origins of European settlements.[14]

Such a mention is not limited to Europe. Bernard Rudofsky (1965) described a picture of pile dwellings in China and New Guinea as follows: 'Pile dwellings held a special fascination for

the founding fathers of modern architecture, who adopted them as *architecture á pilotis*'.[15] Swiss architectural historian Siegfried Giedion, in the introduction of 'Space, Time, and Architecture' (5th ed., 1967), referred to pile dwellings to explain the innovative maritime city designed by Kanzo Tange in the 1960s.[16]

The discovery of pre-historic pile dwellings in the mid-19th century was enthusiastically received by Swiss citizens and was introduced to European peoples at the 1867 and 1889 world expositions in Paris. Thus, it became common knowledge that existed as a major premise for the people of 20th century Europe. In addition, as pointed out in section 1-2, Keller's image of pile dwellings around the Alps was inspired by that of the Pacific area, which means that the image demonstrated global proliferation from the beginning. Therefore, from the 1960s, architectural historians began to use the term 'pile dwellings' in connection with modern architecture in a global context.

It is difficult to find concrete references to pile dwellings by modern architects, with the exception of the examples mentioned in this paper. However, it is thought that Europeans' common understanding of prehistoric pile dwellings at the start of the 20th century became the foundation for using pilotis in modern architecture on a global scale.

Notes

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