The Introduction of Reinforced Concrete in Switzerland (1890-1914): Social and Cultural Aspects

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Reinforced Concrete, introduced in Europe during the late years of the 19th century, has today a well-documented history (see one of the latest publications: Simonnet 2005). Considering this knowledge, my study will, for the essentials, to be confined to the circumstances which favoured the application of this new material in Belle-Époque Switzerland (Schindler Yui 1995) and to a lesser extent those opposed to it.

The technology of reinforced concrete was by no means a simple matter. Few people actually mastered the new techniques and technology, and some even doubted that the material was reliable. As a result, the general public was reluctant to accept the new building technique. For the most part, those opposed to it came from two socio-political milieus: the conservative circles on one hand, and the newly created nature and historical heritage conservation movement, known as *Heimatschutz* (Le Dinh 1992, Clavien 1993, pp. 87-91), on the other.

I propose to analyse some aspects of the introduction of this new material in Switzerland between 1890 and 1914. I will examine and discuss the penetration and spread of reinforced concrete as a potential technology, its first applications, and its incorporation as a discipline taught in relevant industry academies. I will then focus on the public debates and controversies generated by its adoption, the attitudes of the political authorities, as well as the reactions and perceptions of cultural milieus.

Before getting into the subject, we should point out a few ambiguous aspects of this period, marked on one side by a fast and intense technological modernisation, and on the other by an often forceful reconstitution of traditionalist, if not reactionary, forces (Schwengel 1988, Teich/Porter 1990, Kuchenbuch 1992). On this account, we should mention the innovations in fields such as for example automobile, electricity, flying, chemistry, arts and psychology whose implementation coincide with the development of nationalist movements, social-Darwinism, racism and the whole political vision proper to conservative right-wing (see for example Mayer 1983). In this context, the arrival on scene of reinforced concrete crystallized all sorts of fantasies and at the same time symbolize progress or degeneracy of traditional art as far as construction is concerned: admired by some as a technical achievement offering new safety, it was vilified by others as an element of ugliness corrupting the “authenticity” of the landscape.

In Switzerland, the confrontation of the modernisation of social and industrial structures on one hand and the rebirth of conservative forces on the other was experienced on a rather intense level

(Jost 1992). Because of an accelerating urbanization process, these contradictions appear mostly in cities, where reinforced concrete constructions such as bridges in particular, become the emblem of struggles between modernists and traditionalists - whose separation, shall we add, does not necessarily match up with political adherences. But this focalization will bring public opinion to grow suspicious towards concrete in general, feeling which will only very slowly fade out.

It was to self-taught French foreman François Hennebique (1842-1921), that we owe the first steps to introduce reinforced concrete into the country. After having registered his patents in 1892 and founded a firm in Paris, he quickly took foreign agents into his service to implant his manufacturing process. In Switzerland he associated with Samuel de Mollins (1845-1912) an engineer from Lausanne who rapidly established contacts with key figures of industry, construction and public authorities (Gubler 1985). In such a way that in September 1892 already, he displayed in Lausanne a module of a concrete floor and thus demonstrate the reliability of Hennebique's system (Elskes 1924, de Mollins 1893 and 1901). An achievement immediately pointed out by Swiss construction newspaper (*Schweizerische Bauzeitung*), which presents the novelty in 1895 to the field's specialists. As for engineer de Mollins, he pursues successfully his work while achieving several articles of different nature and which will be discussed further on.

About this fast introduction of reinforced concrete, one must underline that quite many concrete manufacturers existed in Switzerland, as well as Portland, produced since the years 1870. In such a way that the making of building stones, floors, walls or bridges in "artificial" materials already belonged to ordinary usage (Birkner 1975, 21-28). Furthermore, the country not only had many limestone sites but hydraulic forces as well to produce electricity, which helped the development of the new technique (Mangold 1931, pp. 14-17). In this context, and given that in this region iron must be imported, use of reinforced concrete instead of large metallic structures offered itself as a worthwhile alternative from an economical point of view. These favourable elements will however not stop the expression of strong reluctances, as can be seen still in 1921 with the words of professor Mirko Ros, director of the federal laboratory of material tests at the time, who said: "Reinforced concrete is an unfortunate misalliance: concrete breaks, iron rusts and theory is on strike" (Ros 1921).

THE FIRST STEP : GAINING TRUST OF ENGINEERS AND PUBLIC AUTHORITIES

If the concrete floor displayed by de Mollins in 1893 arouses the interest and close observation of several engineers, Hennebique's agent doesn't only contact colleagues or building contractors, but undertakes a wide promotion campaign to seduce the public authorities. The method turns out to be fruitful, since the cities of Lausanne, Geneva, Zurich, Basel and Sankt-Gallen grant in 1895 a planning permission according to the Hennebique system. Meanwhile, a "captain" of Lausanne industry, Jean-Jacques Mercier-Marcel (1826-1903), entrusted de Mollins with the building of warehouses for his company, followed in 1897 by the Jura-Simplon railway company who asked

him to construct a small viaduct on its line. Other art works will follow as well as prestigious buildings such as the Hotel des Postes (post office) and the Banque cantonale vaudoise (Vaud State Bank) in Lausanne (Gubler 1985, p. 69 ; Lamber 1905).

Adoption of reinforced concrete seems indeed to progress without to much difficulty. However, already during the first big projects - the building of large bridges in the cities of Geneva and Lausanne - discussions in different expert commissions point out doubts concerning its reliability. And the fans of the new technique being by far the minority, the debate greatly leans towards aesthetical issues. And it's in a climate of uncertainty that a tragic event happens, which seems to prove right reinforced concrete detractors. Indeed, on the 28th of August 1901, a building under construction collapses at Basel, causing the death of several of the site's workers. A wide controversy follows in the press, led among others by experts, in particular an engineer at the service of a metal construction company, which violently attacks the Hennebique system (Rosshändler 1901, Luipold 1901). Forced to intercede, de Mollins personally conducts the defence of the manufacturing process he represents (Mollins 1901b). At that occasion, others don't miss the opportunity to remind that metallic bridges also met the same fate and collapsed as well in dramatic conditions.

The debate will finally settle down thanks to the intervention of two professors of the Swiss Federal Insitute of Technology (SFIT), Karl Wilhelm Ritter (1847-1906) and François Schüle (1860-1925), experts called to the rescue by political authorities. But the doubts remains, and when in 1905 a similar accident occurs at Bern (Schüle and Elskes 1906), critics against reinforced concrete start all over again. Once more called upon, the government reacts and nominates in 1906 a wide federal commission, composed of representatives of the Swiss Cities Association, of the Portland concrete manufactures trade union and of the Swiss Engineers & Architects Society (SEAS). A first network where SEAS representative Robert Maillart (1872-1940) appears, and who will distinguish himself as one of the most talented promoters of reinforced concrete.

So we can see a close collaboration between engineers, building contractors, university professors and local officials. In that regard, circumstances which hosted the building of a (non-reinforced) concrete bridge in the city of Zurich are particularly instructive (**fig.1**). The project being launched in 1899, the local engineer happens to entrust Robert Maillart, young engineer with a fresh SFIT degree, with the concept's development. Karl Wilhelm Ritter, one of his former SFIT teacher advises him, while another, Gustav Gull (1858-1942), the town's architect, draws its shape. Very innovative, the project is submitted to popular vote and accepted by a large majority of citizens (Nievergelt 1995, pp. 161-4).

These bridges however, huge art works built by or in collaboration with local engineers and closely watched by political authorities, soon gain great prestige and a high symbolic value. This is the case for instance with the bridge de la Coulouvrenière in Geneva (1893) or the Chauderon bridge in

Lausanne (1903), the latter being considered as a technical and architectural masterpiece (Gubler 1995, Delacrétaz 1991, pp. 71-8, Birkner 1972, Melan 1906). Curious, the public closely follows the evolution of the building sites before strolling with the family upon these new airways. Trust in concrete, non-reinforced at the beginning, gets slightly better, which will help welcome its extension to other constructions.

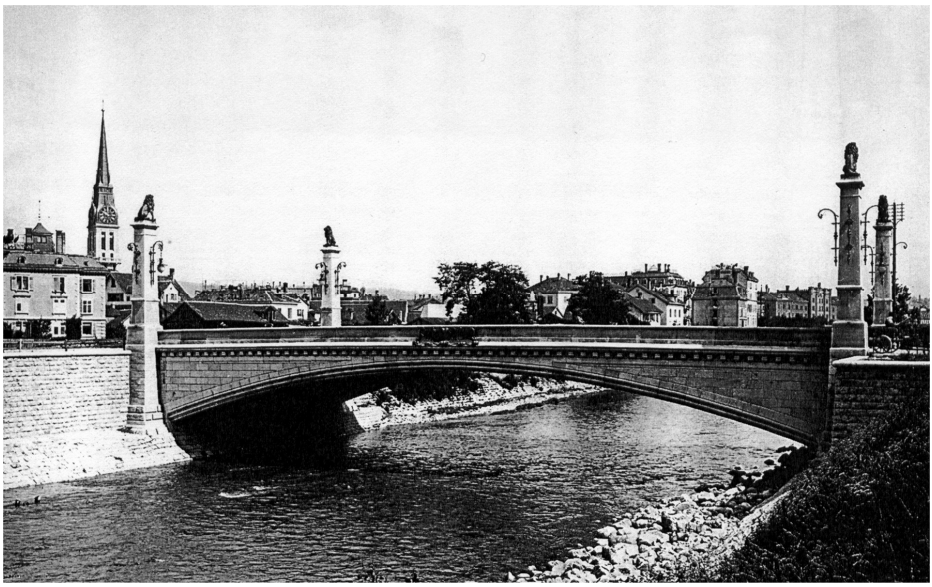

Figure 1. Stauffacher Brigde, 1899, Zürich (Nievergelt 1995, p. 161)

But lets come back to the role by no means insignificant played in this process by some professors in Universities. And lets use as common link Karl Wilhelm Ritter, who teaches graphic statics and bridge construction at SFIT between 1882 and 1904 (M 1906). This because he works not only to deepen scientific control of reinforced concrete (Ritter 1899), but also assumes the position of expert on the matter on many occasions. He attended the first demonstrations of the Hennebique system in Lausanne, and he was the person who intervened in the debate that followed the Basel accident in 1901. Important link of a chain connecting technicians, building contractors, engineers of the federal administration (of which Edouard Elskes, assistant of the chief engineer of the Federal Rail Way and later professor at the SFIT), Ritter also collaborates with professor Ludwig Tetmajer (1850-1905), director of the SFIT laboratory where the construction material is tested (Schüle 1906). As for his colleague François Schüle, besides the shared position during the Basel affair, he joins the network and publishes many articles in the specialized press.

This scientific sociability, so decisive when it comes to the evaluation of a new technology, spreads out thanks to multiple personal contacts, but also through specialized magazines. In that sense,

periodicals such as *Schweizerische Bauzeitung* and *Bulletin de la Société vaudoise des ingénieurs et des architectes* (whose new title after 1900 is *Bulletin technique de la Suisse romande*) offer a wide range of articles and notes about reinforced concrete. As for the review published by the Hennebique company itself, *Le Béton armé*, it is distributed as well in Switzerland. Still rather poorly studied by historians, this press has with no doubt contributed to promote the new technique and enlarging the number of its fans, and favouring its application in construction practices.

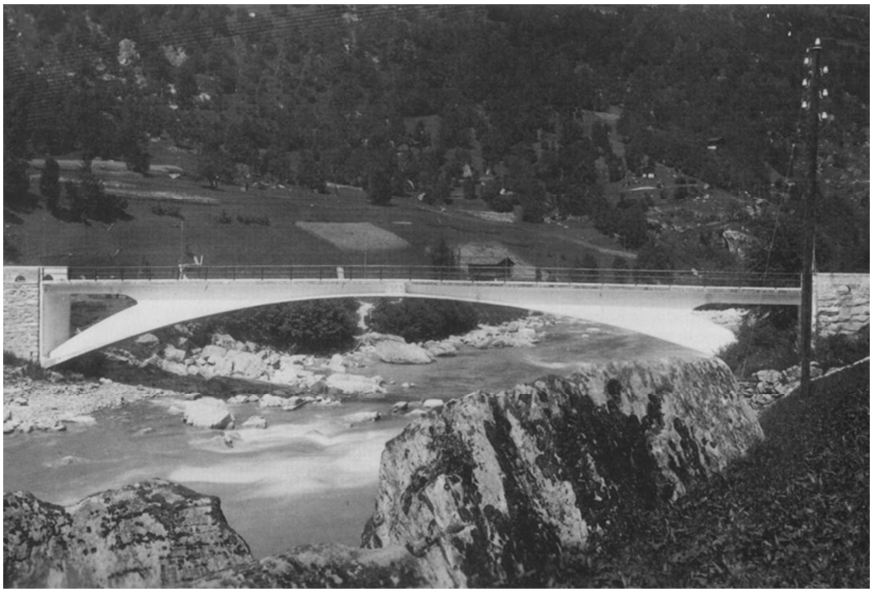

Figure 2. The Bridge of Tavanasa, 1905 (Billington 1990, p. 11)

Robert Maillart (1872-1940) for instance, who deeply marked reinforced concrete history in Switzerland (Billington 1997, Bill 1955, Giedion 1940), rises with this specific sociability in the background. A recognized personality because of his amazing talent, he studied engineering at the SFIT from 1890 to 1894, at the time the Hennebique system introduced itself in Switzerland. After his studies and three years in a private construction company, Maillart starts working for the town of Zurich where, as spoken of earlier, he takes part in the building of the first concrete bridge of the city. Very active amongst his peers, he assumes the secretaryship of the SEAS – of which he is one of the delegates in the federal commission created in 1906 -, and will publish many articles about concrete construction in *Schweizerische Bauzeitung* among others. Without wishing to relate Maillart's whole career path, let us just note that he had about two hundred projects to his credit, the first of which being the Stauffacher Bridge at Zurich (1899), and the last an monumental vault for the 1939 National Exposition. What one especially remembers of his work however, are his reinforced concrete bridges (like the famous bridges of Tavanasa, 1905 (**fig.2**), and Salginotobel, 1929/30), whose monumental elegance has given the Swiss Alps a new aesthetical feature.

THE SECOND STEP : GIVE CONCRETE A POSITIVE IMAGE

Often put in the hot seat and in public debate, reinforced concrete gave rise to passionate controversies. The disasters in Basel and Bern provoked a heavy volley of expertises and second expertises, and harmed people's trust in the reliability of engineer's work. In such context, contradictory discussions about aesthetics, cultural connotations and symbolic signification became more important. Nevertheless, companies and project managers involved in the process grasped what was at stake in such confrontations, and were able to develop a subtle strategy to favour a positive perception of concrete's presence in the landscape.

The first such operation is organized by SFIT professor Ludwig von Tetmajer, and is part of the 1883 National Exposition in Zurich. In a common space, a group of Portland concrete producers display their products, with a climax: the presentation of a small arch-like bridge made of only concrete, which reaches out six meters, and named "devil bridge" by the audience. But the actual Devil Bridge is in fact a bold achievement which, by opening the Gotthard pass in the 13th century, allowed Switzerland to join the great commercial path which links Italy to Flanders and England. Besides its not inconsiderable influence on the country's economical development, this bridge, suspended over very deep gorges, aroused many artists' and writers' romantic inspiration, whereas its long history became a legend and grew to be a national myth. The visitors to the 1883 Exposition are all the more receptive to the shows as the building of the Gotthard railway tunnel just finished and the spectacular demonstrations of the strength of the so-called "devil bridge" brings back and combines all sorts of images of tales old and recent. Thus the operation of concrete promoters succeeded not only in creating some kind of familiarity with the new product, but also by opening the door of its implementation in the field of the symbolic values of the country.

Figure 3. The "devil bridge" at the National Exposition, 1883 (Birkner 1975, p. 21).

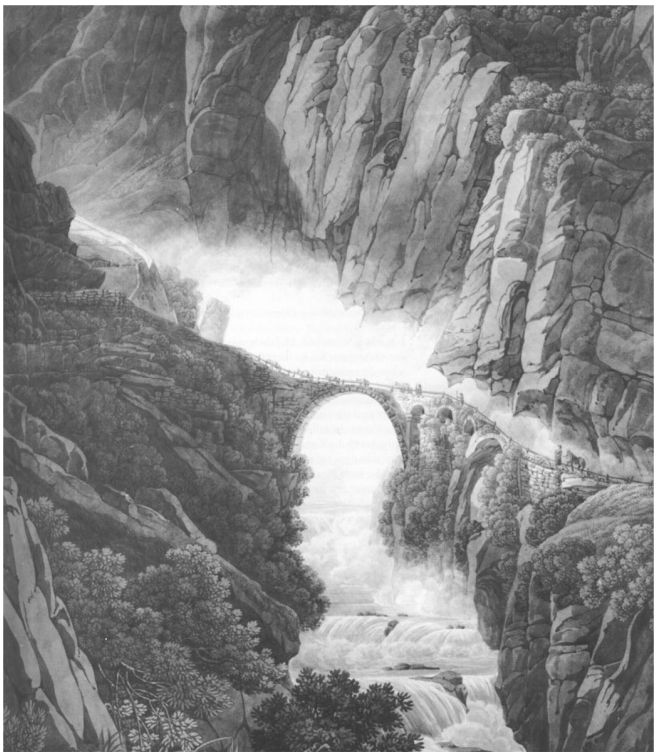

Figure 4. The "Devil Bridge" on the Gotthard, sketch by P. Birmann (Kupferstichkabinett Basel)

Thirty years later, another set connoted with the same alpine clichés attracts grand public attention: Two siloes the Confederation built near the Gotthard railway, in Altdorf to be precise, cradle of primitive Switzerland. Conceived to stock wheat, they are a part of the measures the Government took concerning national defence. One of the sheds was by way made by Robert Maillart and holds on pillars built according to the "champion-slab" system, invented a few years before (Iten 1990, pp. 390-3). But the fact is the massive silhouettes of the set provoke many remarks of all kind. The last word belongs to René Morax (1875-1963), a very popular writer and dramatist who dedicated to the Altdorf warehouses a long article with an allegorical title: "L'église fédérale" ("the federal church"). About the looks of one of the constructions and using prose not without the typical ambiguities of the Belle-Époque, he writes :

> It joins the naked simplicity of the roman basilica and the severe line of modern buildings. This is a thought the architect translated to its best. It's the symbol of this military religion, which expanded so widely in the 19th century and which can be credited of many adepts still today. […] It's the triumph of reinforced concrete.
>
> (Morax 1913)

Figure 5. The siloes built by the Confederation at Altdorf 1912/13 (Iten 1990, p. 392)

It's impossible to underline here all the cultural and historical aspects these buildings represent. Let us just point out that the region of Altdorf is located in the heart of catholic and conservative Switzerland, which fought against the advent of a modern federal State in 1847. In that sense, these edifices, which marry two values defended by the Liberals, technical progress and national defence, are perceived as a symbol of their victory over conservative opposition. To briefly summarize the situation, reinforced concrete implemented itself in Switzerland's heart, in an area, which reunites the Gotthard railway tunnel and the army's fortifications, under construction since the years 1880. So its in one of the most important places of patriotism in terms of collective imagination, that stand theses federal warehouses, whose food supply function for national defence strengthens even more its emblematic reach.

On a more general level, debates on reinforced concrete are mostly driven by *Heimatschutz*, in fact the movement for the protection of picturesque Switzerland (Le Dinh 1992). The review of the movement accuses for example the Altdorf warehouses of being a "grotesque desecration of nature" (Heimatschutz, no 8, 1913, p. 159; Moser 1907). But its protagonists sometimes change their mind and attitude, as when they realize, after having compared metallic bridges (Elskes 1902) to the new concrete constructions, that the latter's texture happens to fit in Switzerland's rocky massif's granite better (Montenach 1908, p. 232).

Thanks to the technical knowledge developed in the SFIT and to the talent of a few engineers, the building of bridges quickly expands. The aesthetic quality of these achievements is more and more acknowledged, which withdraws the process' bad reputation. And during the 1939 national

Exposition, reinforced concrete even has the place of honour. As if thrown towards the sky and dominating the construction sector, a daring reinforced concrete vault is exhibited, a blend of both technical progress and aesthetical feat (Wagner 1940, pp. 210, 220-1). Created by Robert Maillart, this elegant structure is moreover underlined by the presence at its feet, on the forefront, of an impressive sculpture made of concrete as well (**fig.6**). This disposal indeed also shows that concrete, denigrated in its early years, because considered ugly and vulgar, has now won its pedigree.

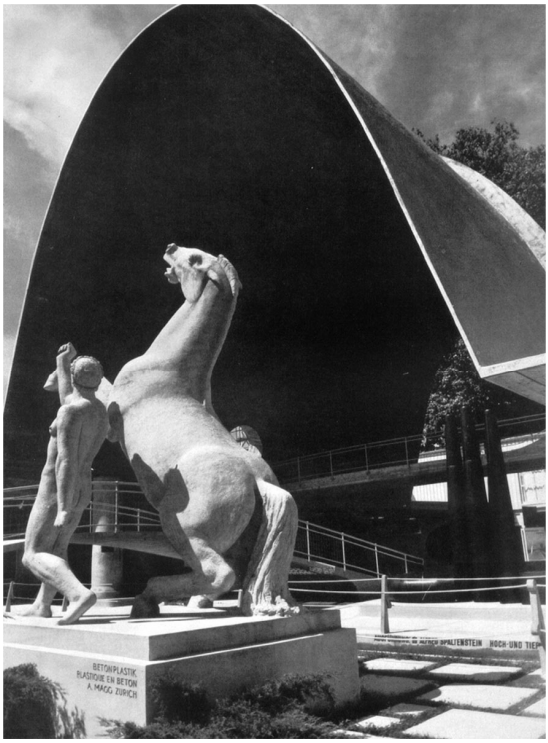

Figure 6. Vault and sculpture at the National Exposition of 1939 (Wagner 1940, p. 221)

CONCLUSION

From this brief study on the introduction of reinforced concrete in Switzerland, we can draw a few conclusions. The success of a new technology not only relies on its technical qualities, but above all depends on their recognition and their diffusion in public space. Social networks and different actors - building contractors, engineers, financials, politicians - play in this scene a decisive part. At least as long as they prove to be able to create together a trustful climate, and a vision which links technology with cultural and political values. The homology made in Switzerland between reinforced concrete and granite in a “nationally” considered nature, as well as the acceptance of the

new technique by the Confederation and its scientific supervision by SFIT professors, have all contributed its expansion. And when during World War II the Swiss army retreats in the Alps and builds a large fortification system, reinforced concrete becomes a close to mythical component of national defence. And as for the latest manifestation of this mental construction, which directly refers to reinforced concrete's quality, it surely lies within the commonly admitted hotchpotch of Alpine fort, national defence and bank secrecy.

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