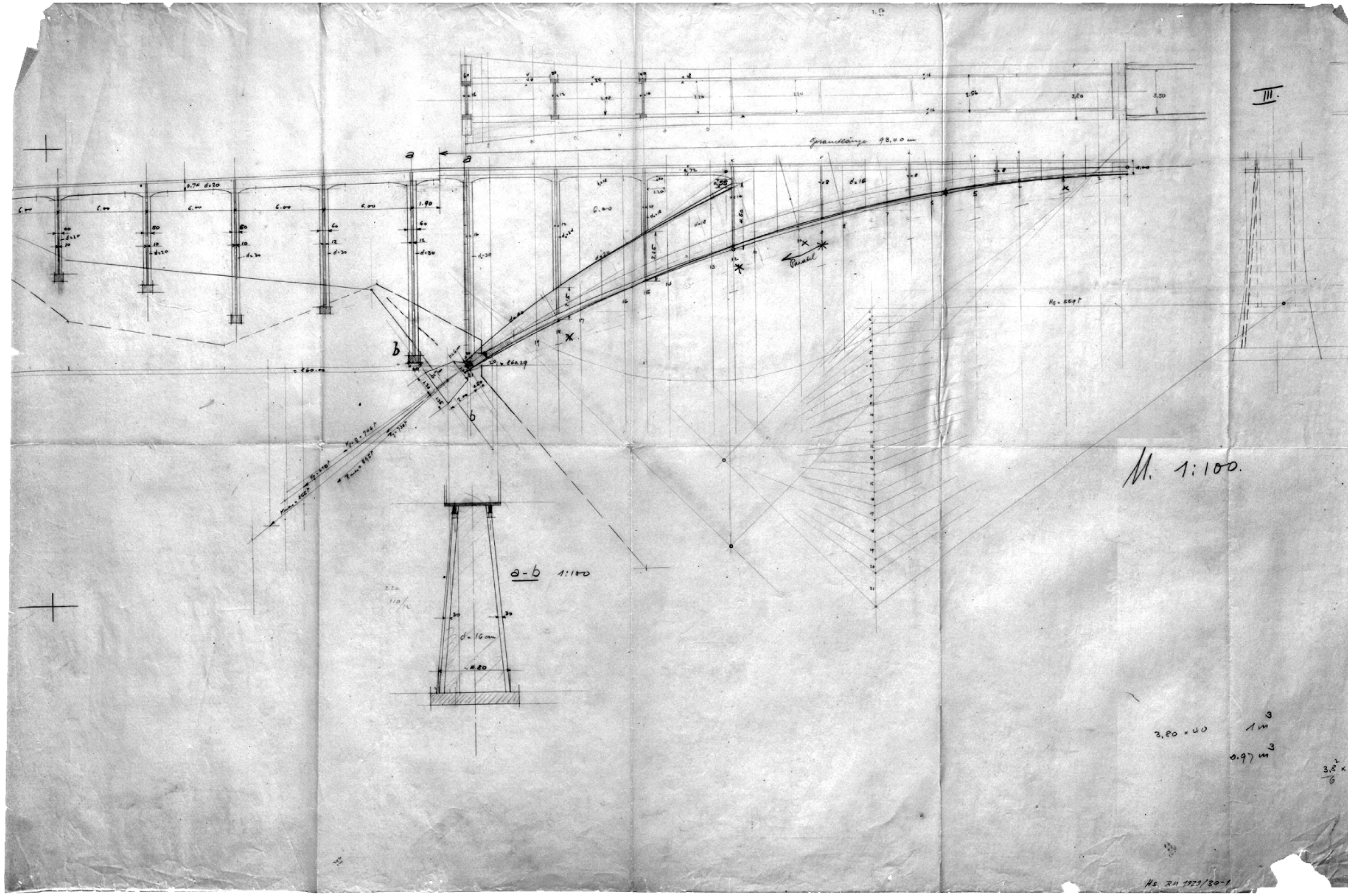
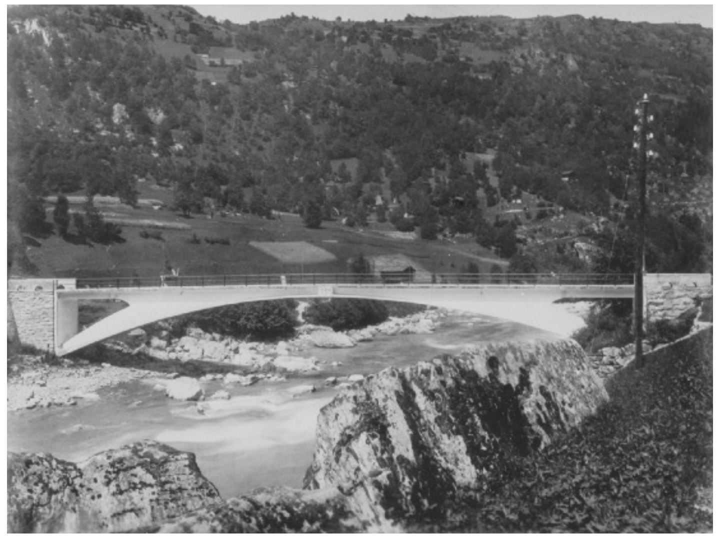


Drawing Structures GC Y1_2025

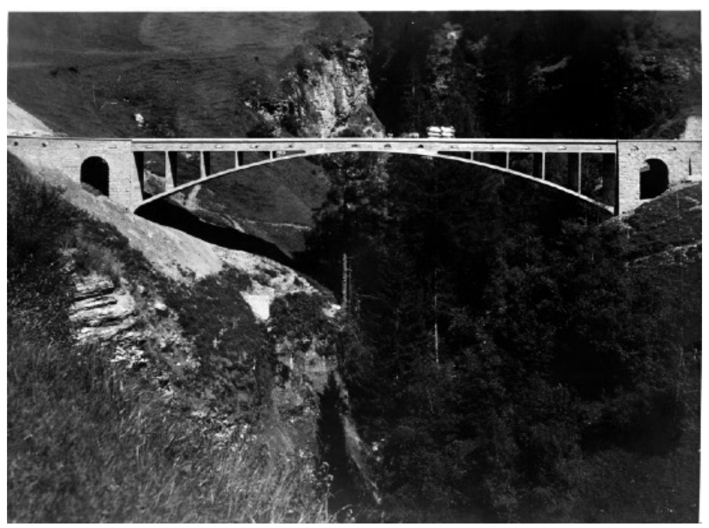
EPFL 2024/25 Patricia Guaita, Raffael Baur

Robert Maillart

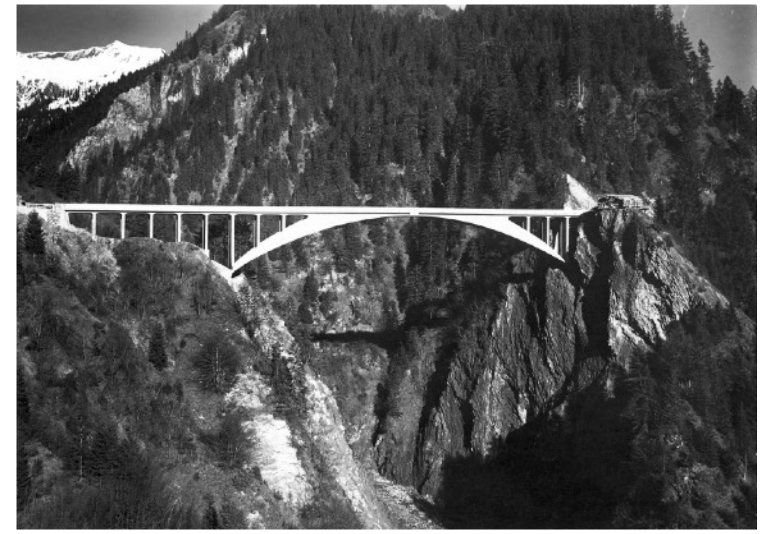
selected bridges



1_Rhein-Brücke, Tavanasa, 1905, 51.0m



2_Val Tschiel-Brücke, Donath, 1925, 43.2m

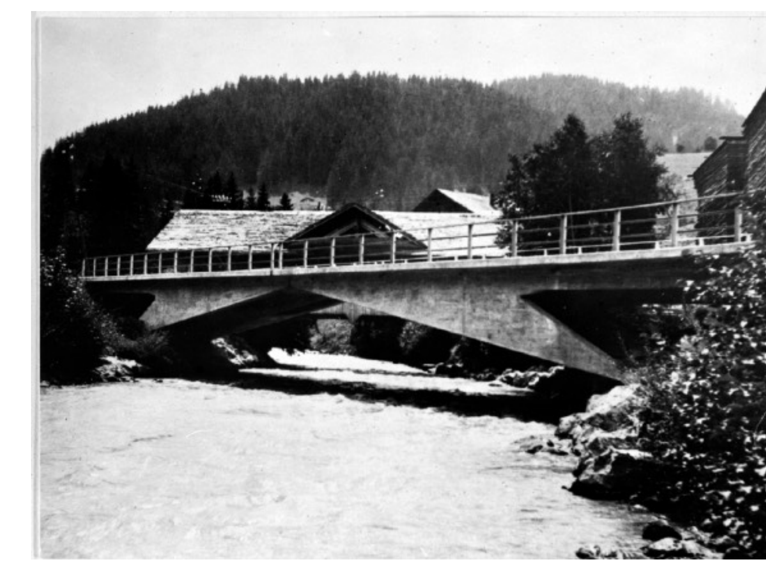


3_Salginatobel Bridge, 1930, 90.0m

4_Schwandbach Bridge, 1933, 37.4m

5_Thur-Brücke, Felsegg, 1933, 72.0m

6_Arve-Brücke, Vessy-Genf, 1936, 56.0m



7_Brücke über die Simme, Garstatt, 1939/40, 32.0m

photos ETH Bildarchiv

Robert Maillart
1872-1940

Robert Maillart, ca. 1925

1890-1894 ETH Zürich

1897-1899 Tiefbauamt Zürich

1899-1901 Fronté & Westermann

1902 Maillart & Cie, Zürich

1914-1918 Riga (St. Petersburg, Charkov)

1919 Maillart Ing., Genève

selected bridges

1899 Stauffacher Bridge, Zürich

1901 Zuoz Bridge; ***the concept of the arch as hollow box***

1_ 1905 Rhein-Brücke, Tavanasa
three-hinged, hollow-box arch, 51.0m
destroyed 1927

1923 Fliegenlibach Bridge; ***the concept of the deck-stiffened arch***
replaced 1969

2_ 1925 Val Tschiel-Brücke, Donath
deck-stiffened arch, 43.2m

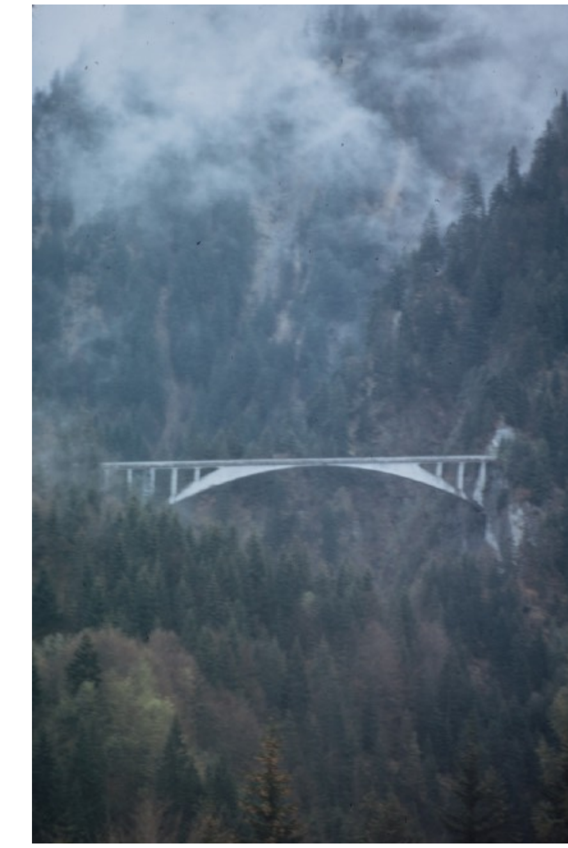
3_ 1929/30 Salginatobel-Brücke, Schiers
three-hinged arch, 90.0m

4_ 1933 Schwandbach-Brücke, Hinterfultigen / Schönentannen
deck-stiffened arch, 37.4m

5_ 1933 Thur-Brücke, Felsegg
three-hinged arch, 72.0m

6_ 1936 Arve-Brücke, Vessy-Genf
three-hinged arch, 56.0m

7_ 1939/40 Brücke über die Simme, Garstatt
three-hinged arch, 32.0m



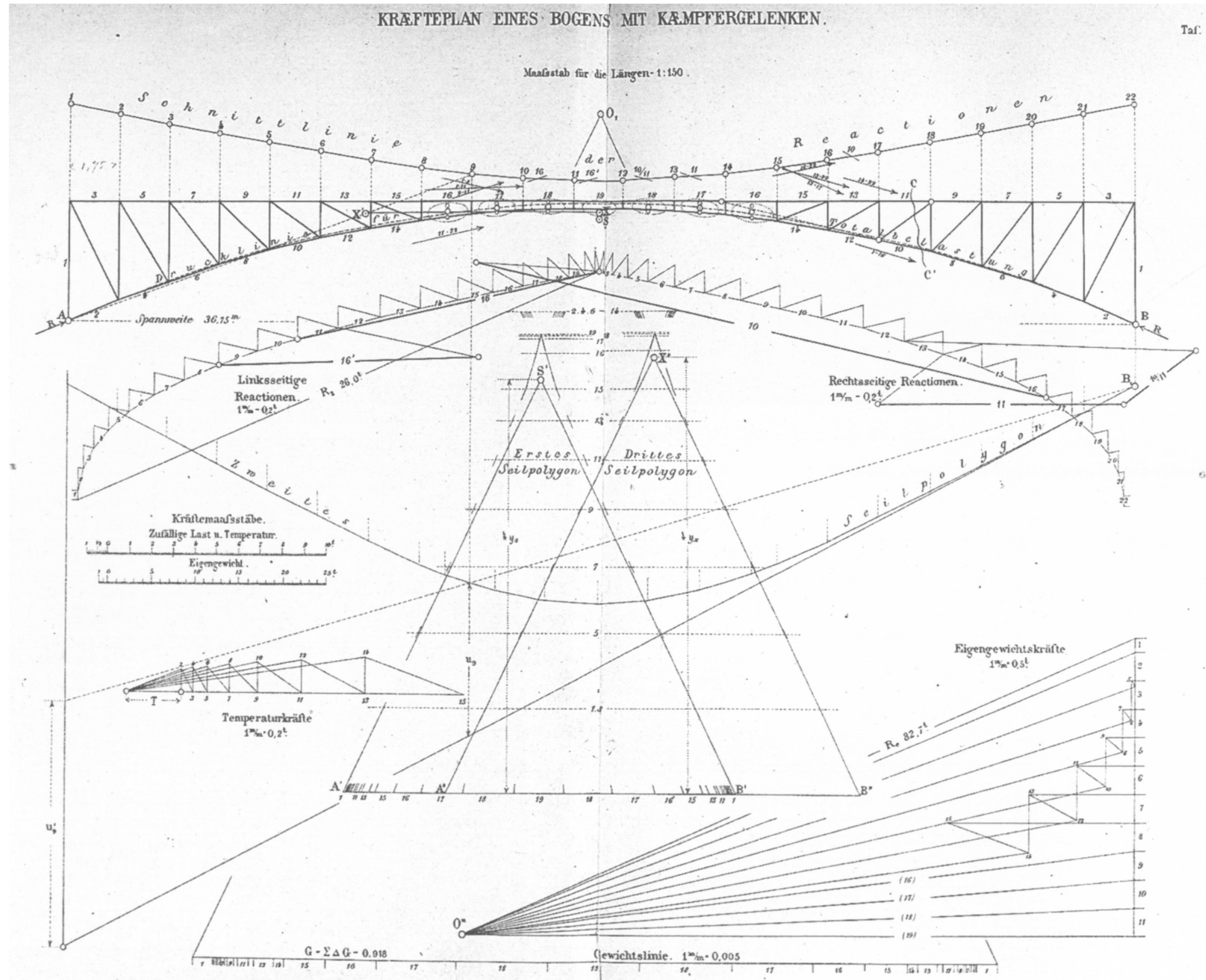
Salginatobel Bridge, 1930

Schwandbach Bridge, 1933
photos ETH Bildarchiv

la statique graphique

Carl Culmann, Prof. ETHZ 1855-1881
Die graphische Statik, 1866

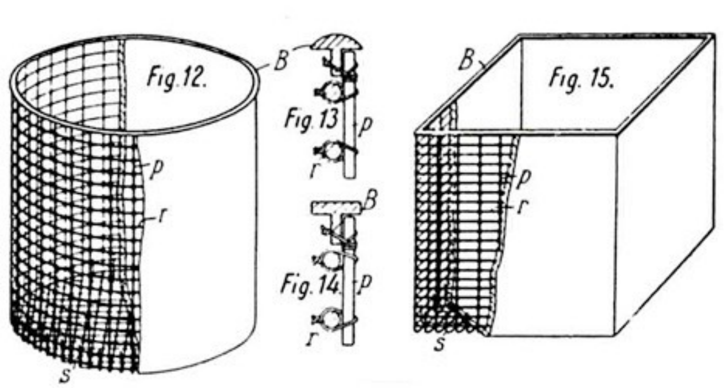
Wilhelm Ritter, Prof. ETHZ 1882-1905
Anwendungen der graphischen Statik, 1888-1906



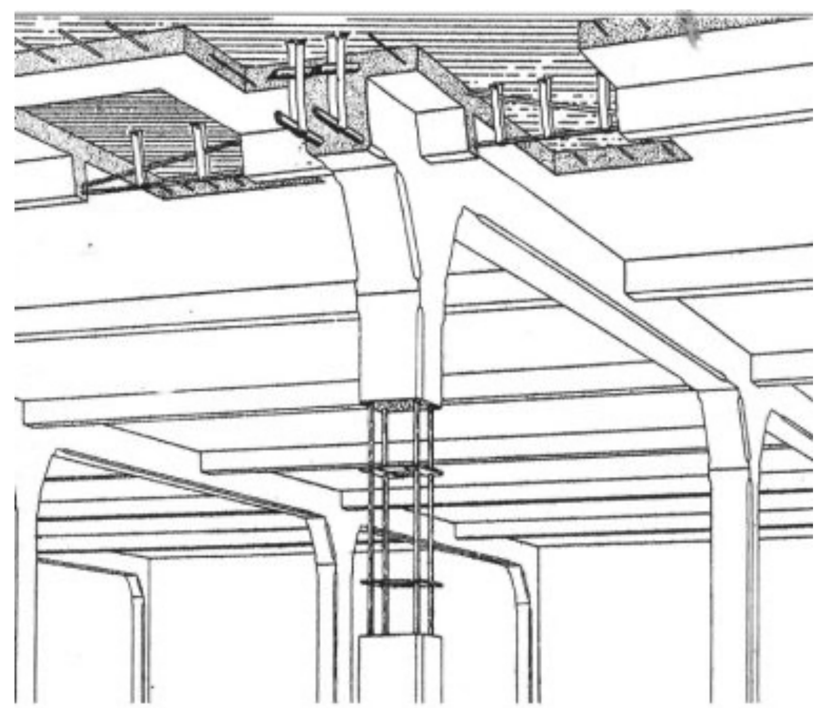
Wilhelm Ritter, *Anwendungen der graphischen Statik, 1888-1906*

Wilhelm Ritter
Die Bauweise Hennebique, SBZ 33, 1899

Robert Maillart
Das Hennebique-System und seine Anwendungen, SBZ 37, 1901

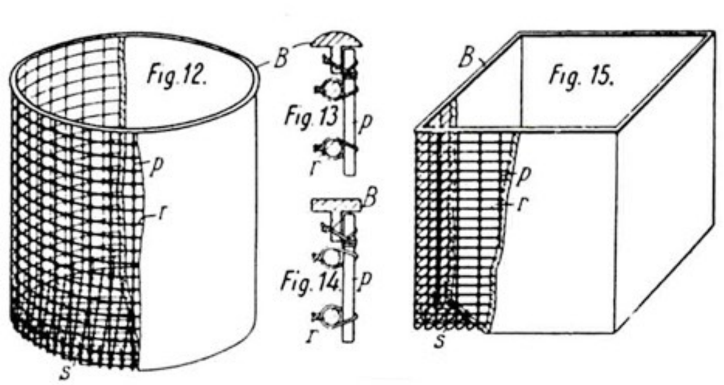


Joseph Monier, first patent for
Iron + Cement, 1867

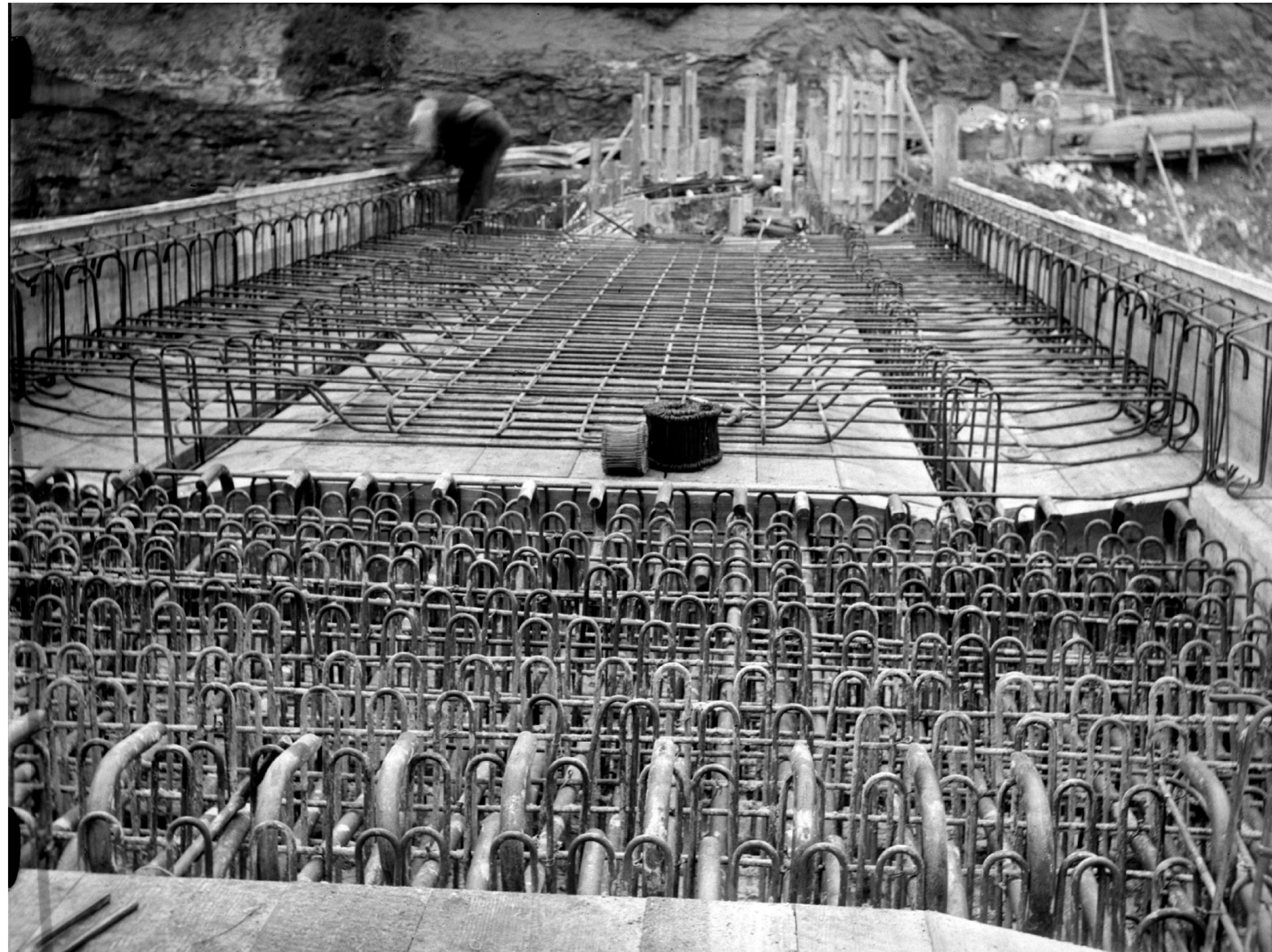


François Hennebique,
Béton armé, système Hennebique, 1892

Pont sur la Vienne, Châtellerault, 48.0m, 1899
Système Hennebique

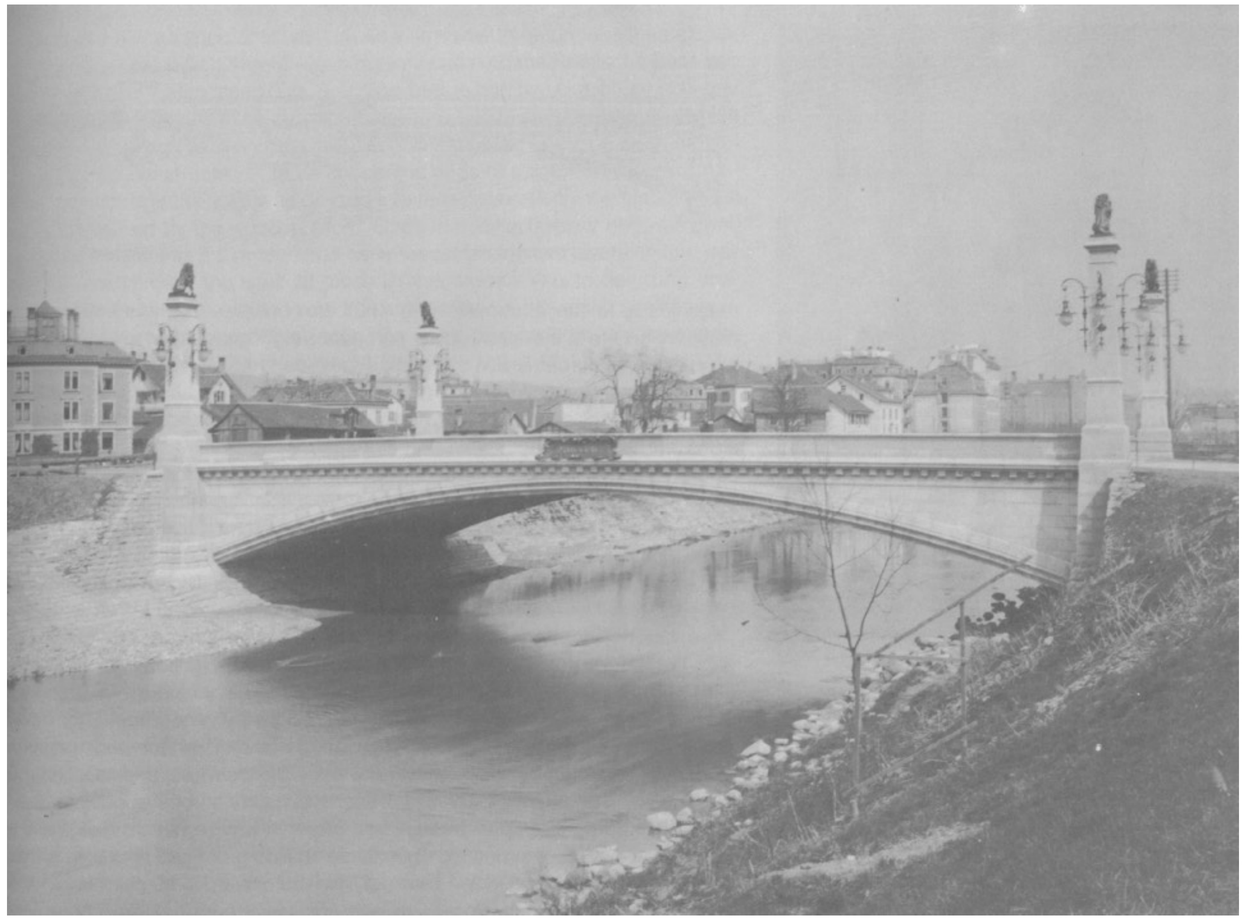


Joseph Monier, first patent for
Iron + Cement, 1867

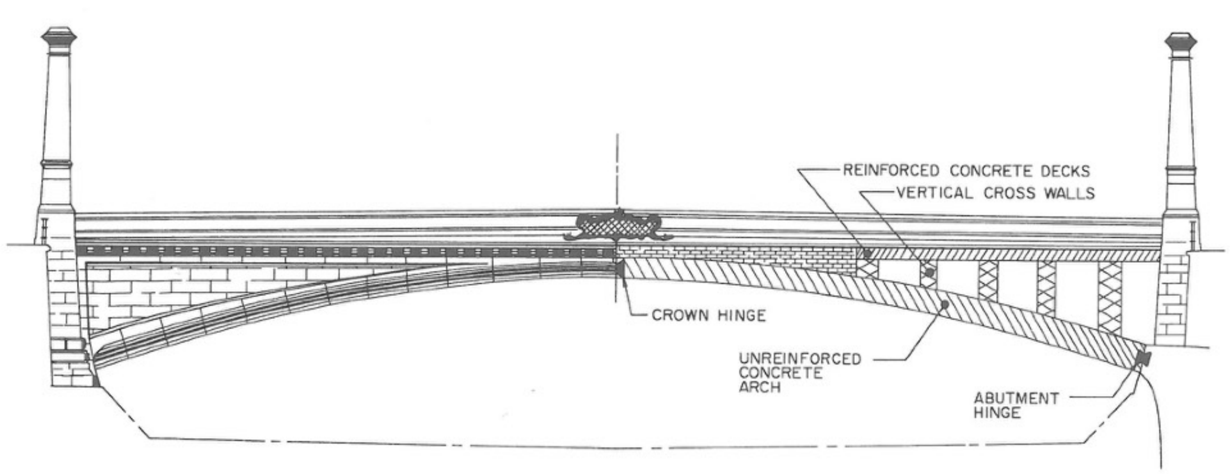


Rossgraben-Brücke, armature an acier, 1932

Robert Maillart *first bridges*



Stauffacher Bridge, Zürich, 40.0m, 1899
Maillart for Tiefbauamt Zürich

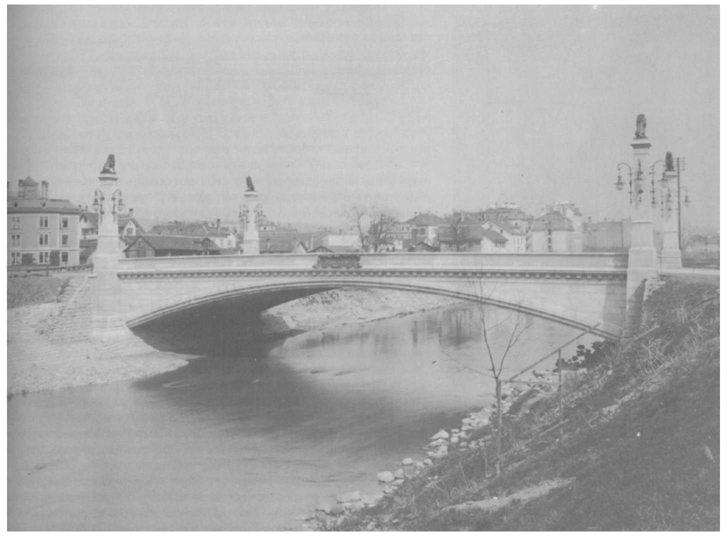


Stauffacher Bridge, 1899, section

Robert Hooke: *„As hangs a flexible cable so, inverted, stand the touching pieces of an arch."* 1671 (1705)
catenary line: pure tension / arch: pure compression
(no bending moments)

Robert Hooke, painting by Rita Greer

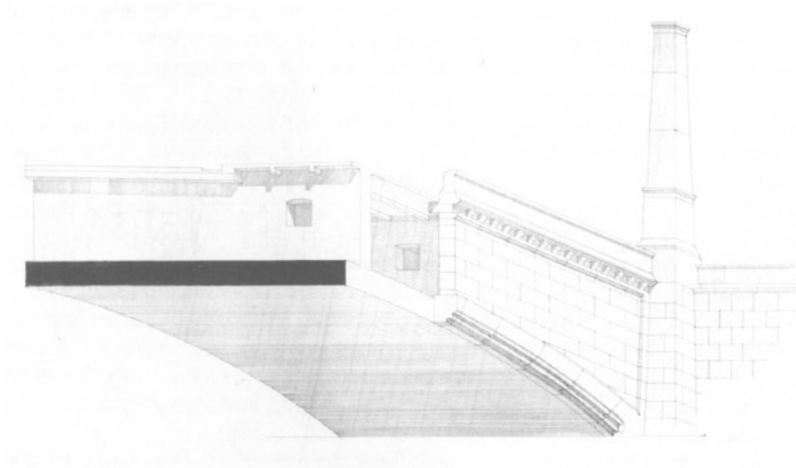
Robert Maillart *first bridges*



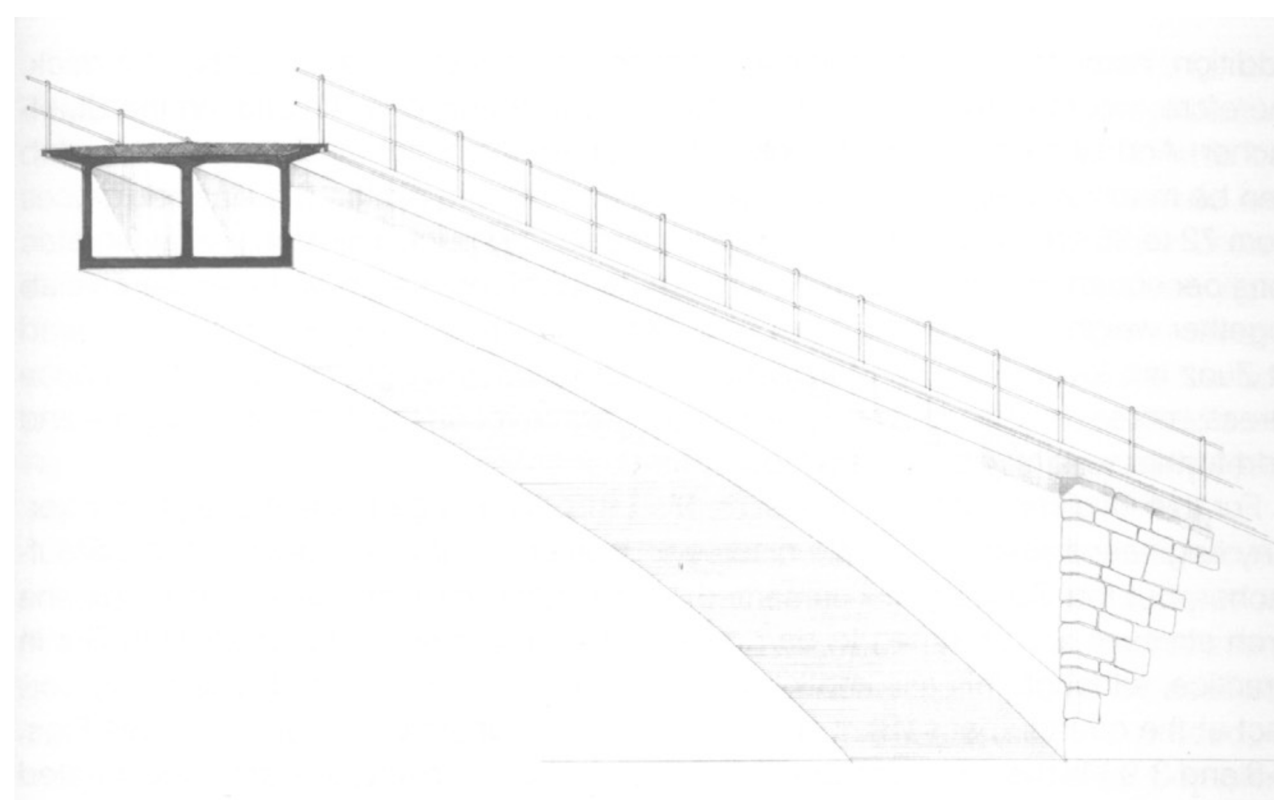
Zuoz Bridge, 38.0m, 1901
Maillart for Fronté & Westermann

The deck slab and walls act together to carry their own loads and, in addition, to help carry the arch slab. And since the straight deck slab helps the arch slab, the arch slab can be much thinner.

- David P. Billington (Robert Maillart's Bridges; The Art of Engineering)



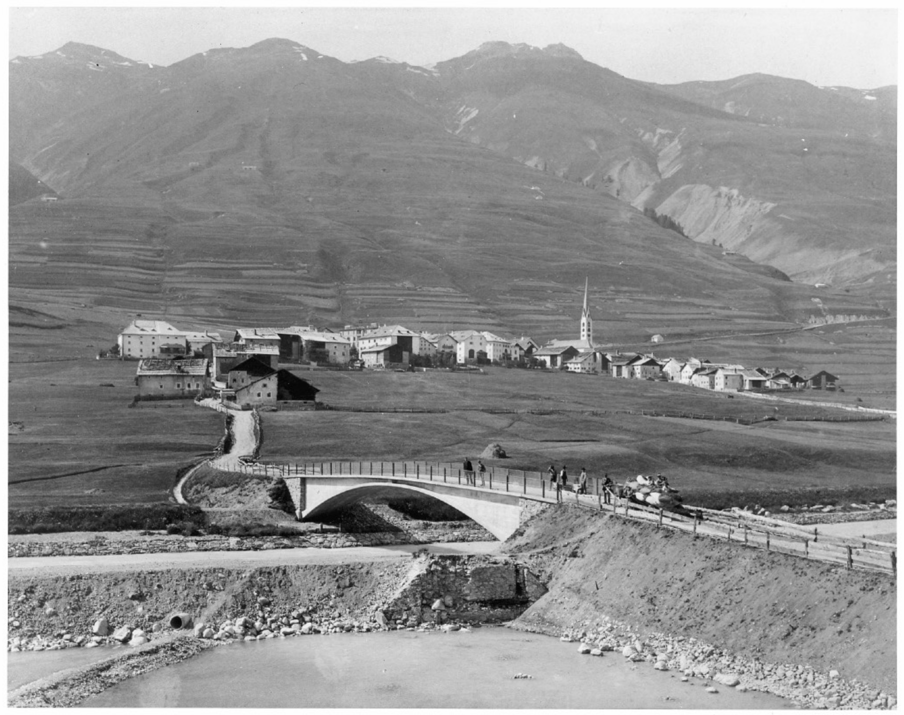
Stauffacher Bridge, 1899,
section showing concrete slab



Zuoz Bridge, section showing hollow box

Robert Maillart

the concept of the arch as hollow box (l'arc en caisson)



Zuoz Bridge, 38.0m, 1901

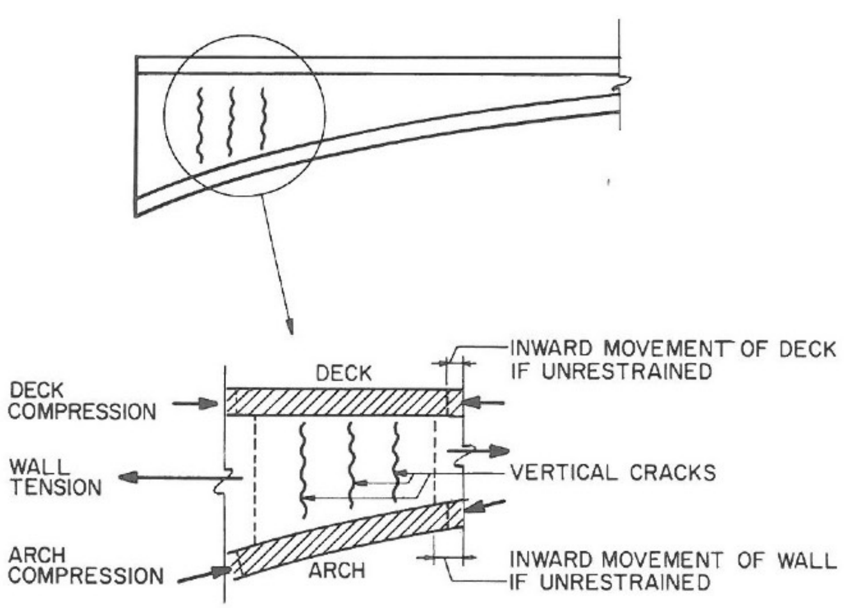
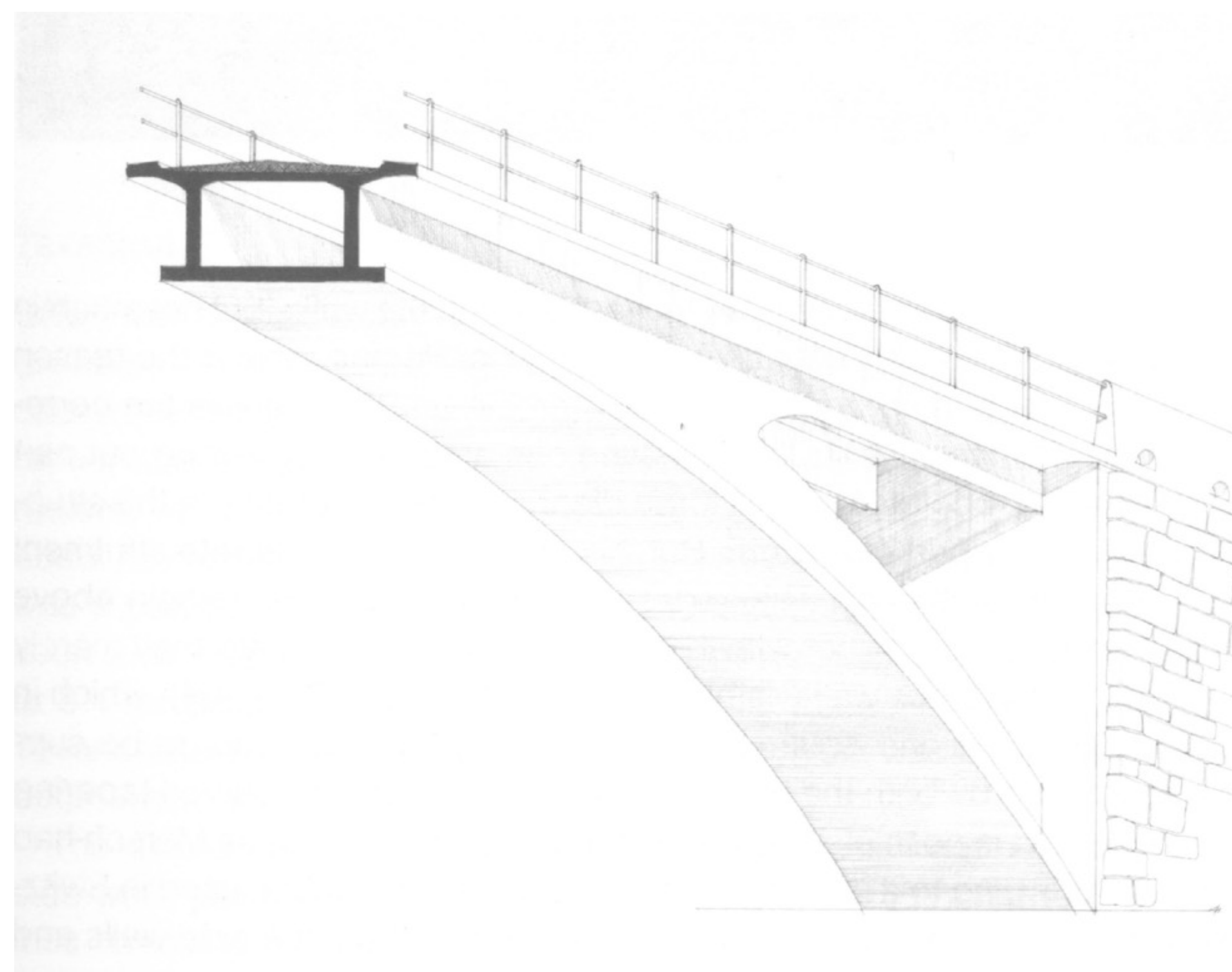


Fig. 4-3. Vertical cracks in the Zuoz bridge



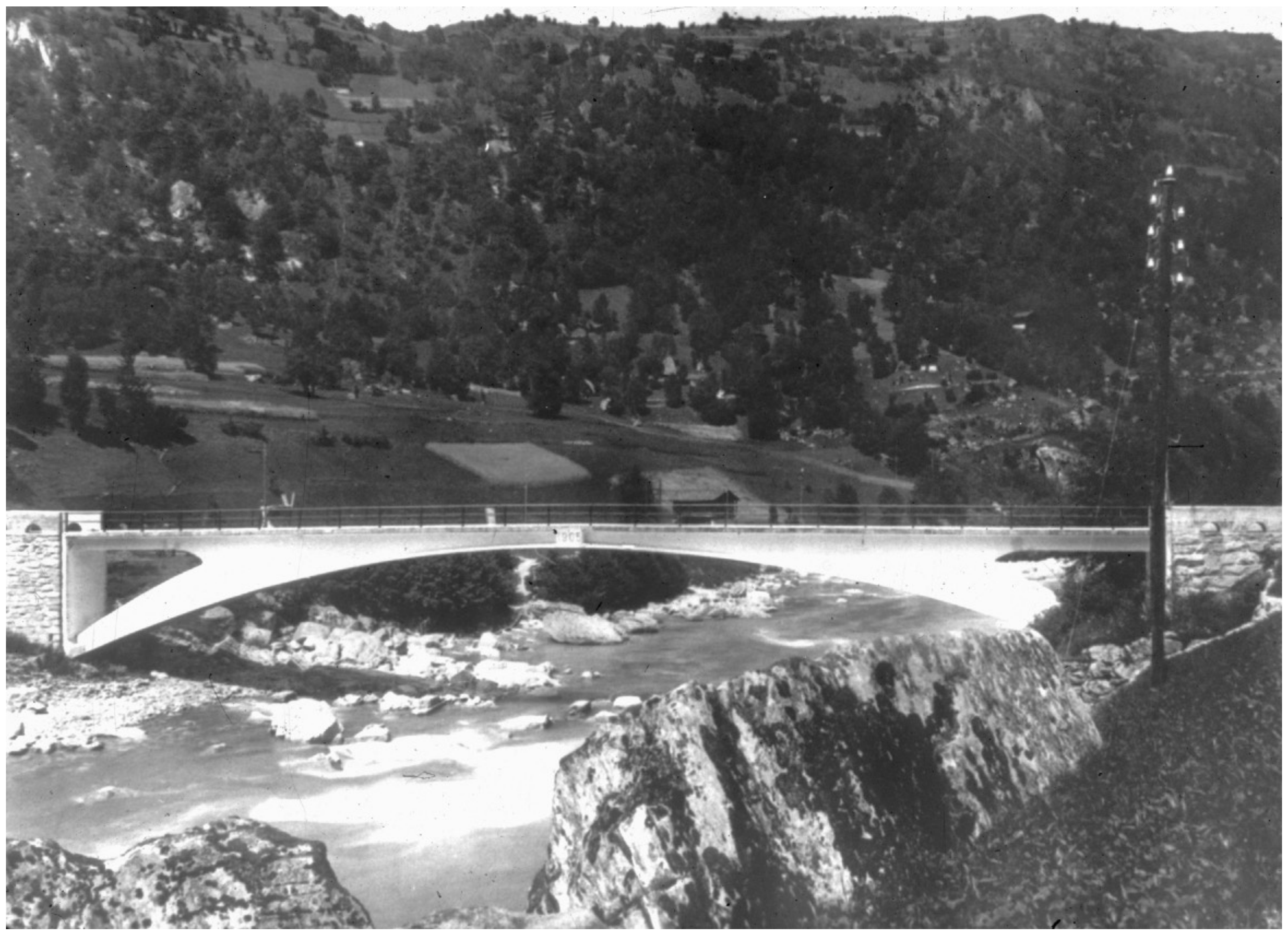
Tavanasa Bridge, section: the structure as hollow box

The realization that, as a link between the arch and the platform, solid spandrels serve no useful purpose except in the middle of the bridge, and that close to the abutments they exert a useless dead weight which is positively a potential danger, had led to the practice of slotting triangular cavities out of them.

- Robert Maillart (in David P. Billington: Robert Maillart's Bridges; The Art of Engineering)

Robert Maillart

the concept of the arch as hollow box (l'arc en caisson)



Tavanasa Bridge, 51.0m, 1905
Maillart & Cie

Robert Maillart

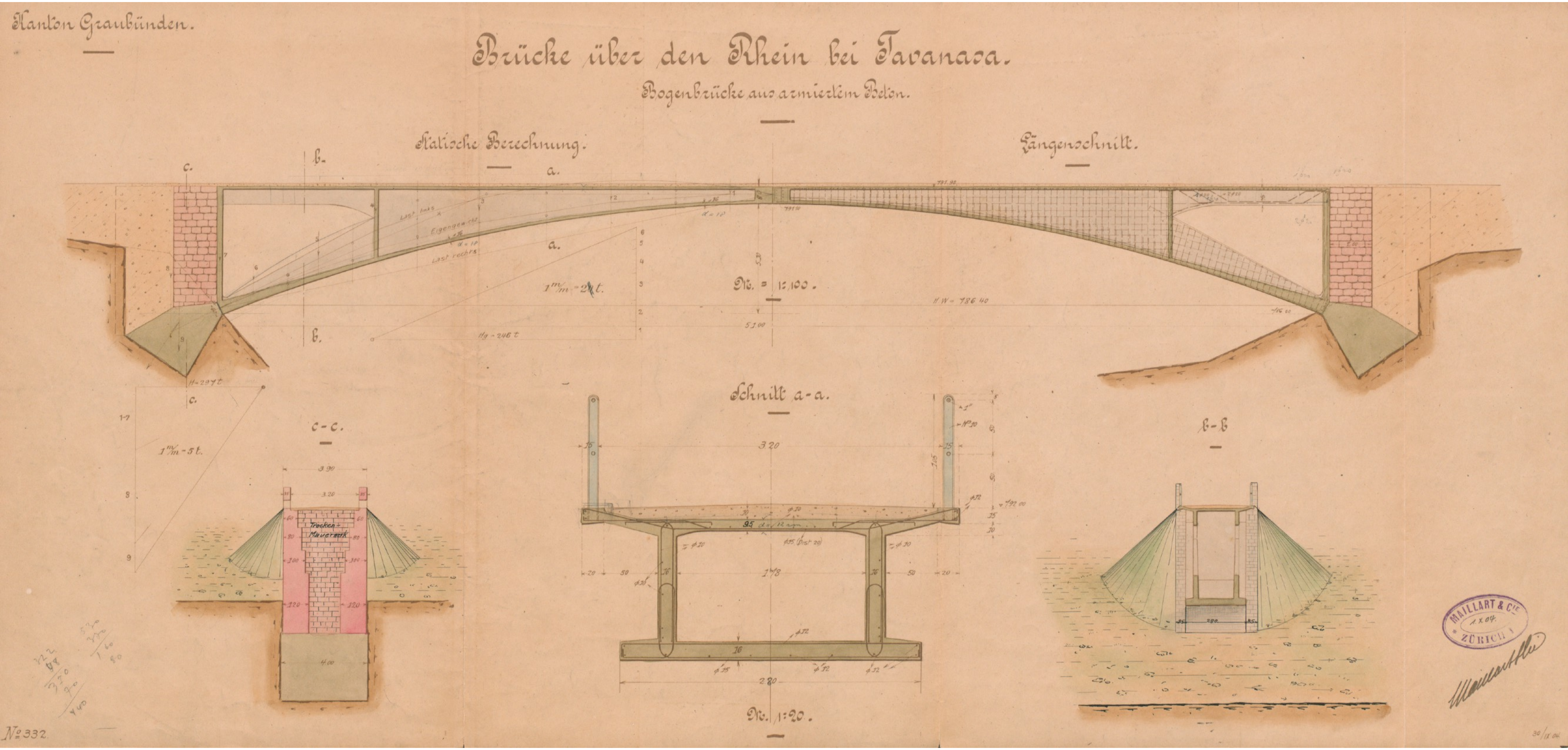
the concept of the arch as hollow box (l'arc en caisson)

Pont sur la Vienne, Châtellerault, 48.0m, 1899
Système Hennebique

Tavanasa Bridge, 51.0m, 1905
Maillart & Cie

Robert Maillart

the concept of the arch as hollow box (l'arc en caisson)



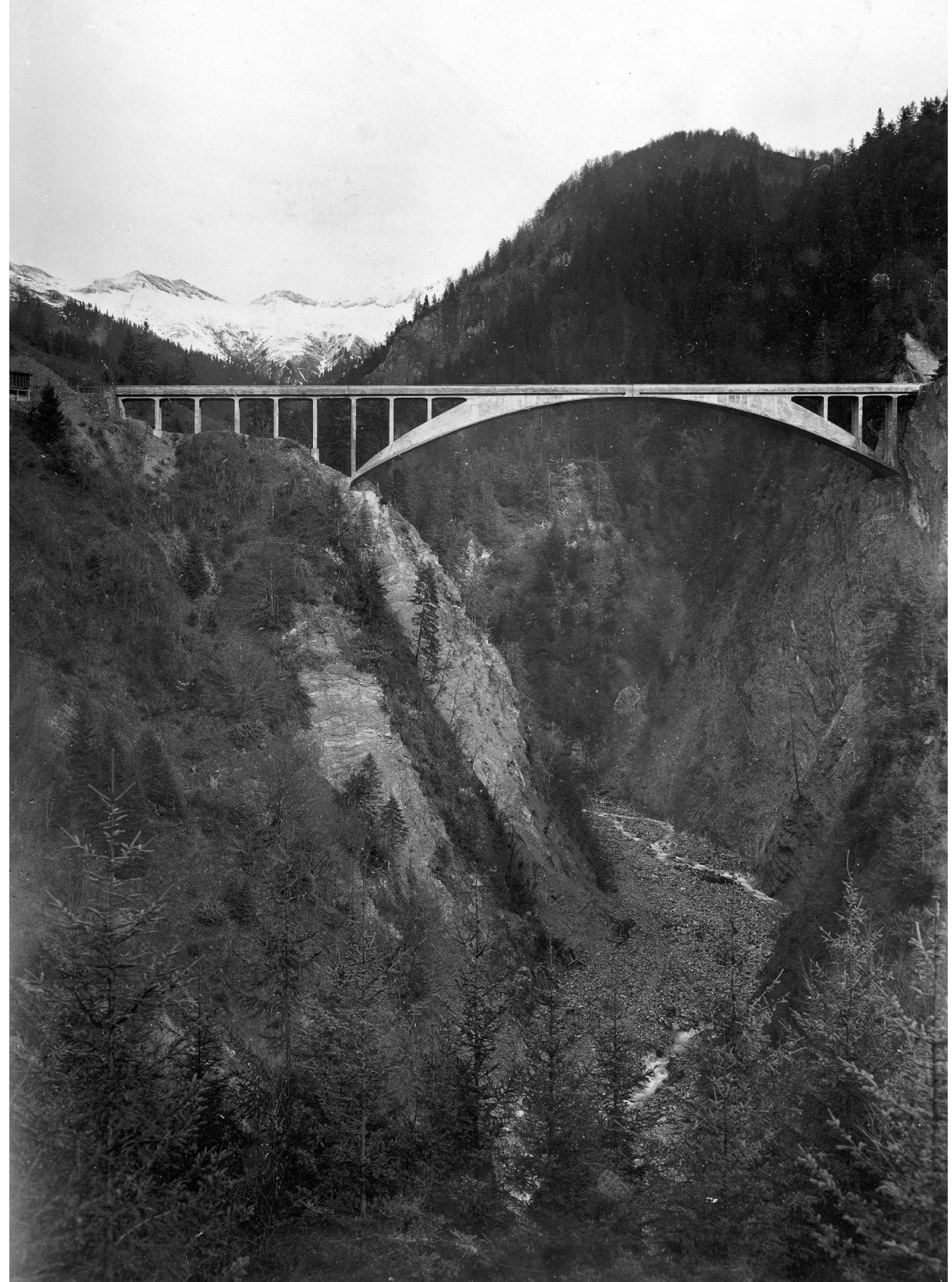
Tavanasa Bridge, 1905, drawing, ETH Bildarchiv

Robert Maillart

the concept of the arch as hollow box
(l'arc en caisson)

„The whole bridge (platform, spandrels, and curved slab), and not merely the principle parts of it, forms the arch.“

- Robert Maillart (in David P. Billington: Robert Maillart's Bridges; The Art of Engineering)

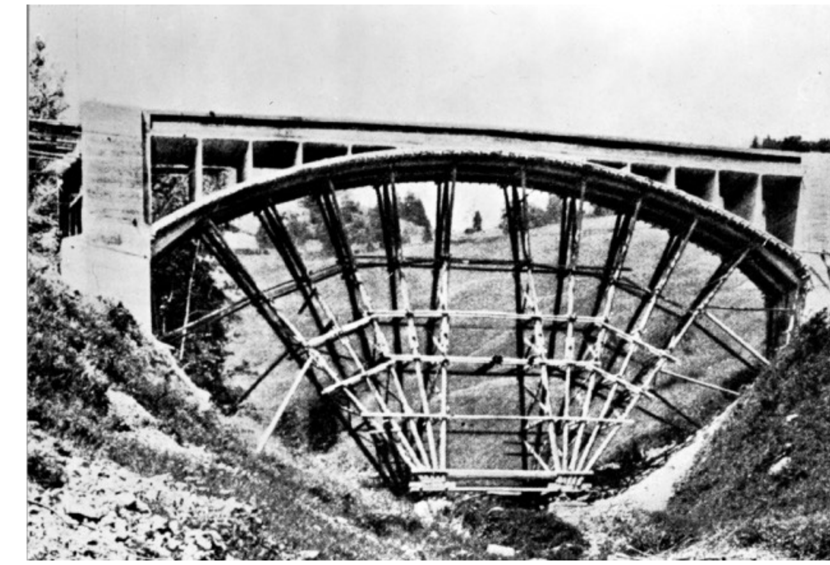


Salginatobel Bridge, 90.0m, 1930

Robert Maillart

the concept of the deck-stiffened arch (l'arc raidi)

Val Tschiel Bridge, 37.4m, 1925
Maillart Ing.



Flienglibach Bridge, 1923

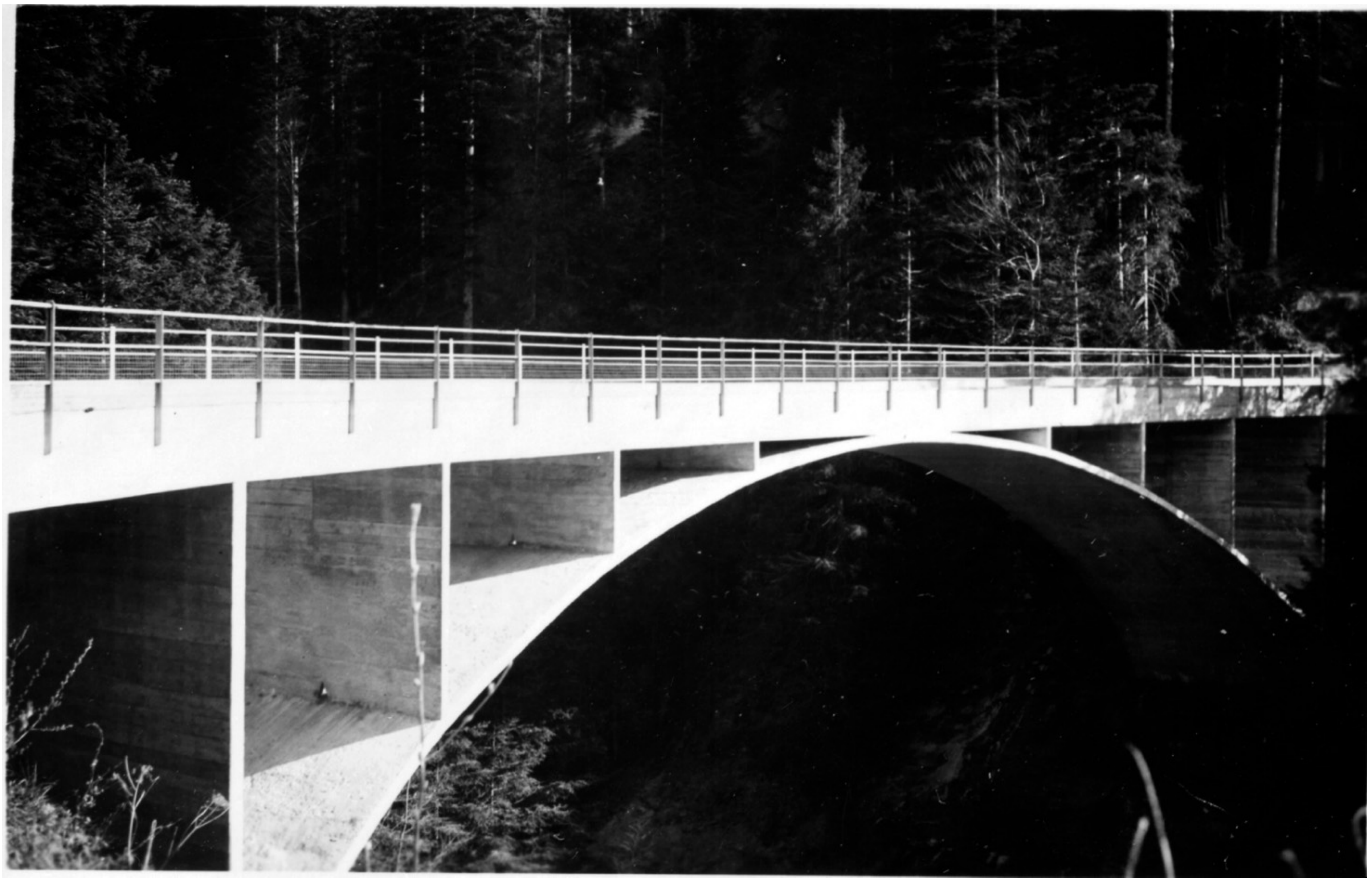
It was not until 1923 that Maillart picked up again the line of thinking begun with Zuoz, and converted it into a new deck-stiffened form for the Flienglibach bridge.

The idea is relatively simple, and consists of designing a stiff longitudinal parapet that serves as a straight deck-girder and is connected through slender transverse cross walls to a thin arch below the deck.The stiff parapet prevents the arch from bending under heavy traffic loads, and thus permits the use of an arch as thin as can be accurately built.

- David P. Billington: Robert Maillart's Bridges; The Art of Engineering

Robert Maillart

the concept of the deck-stiffened arch (l'arc raidi)



Schwandbach Bridge, 1933

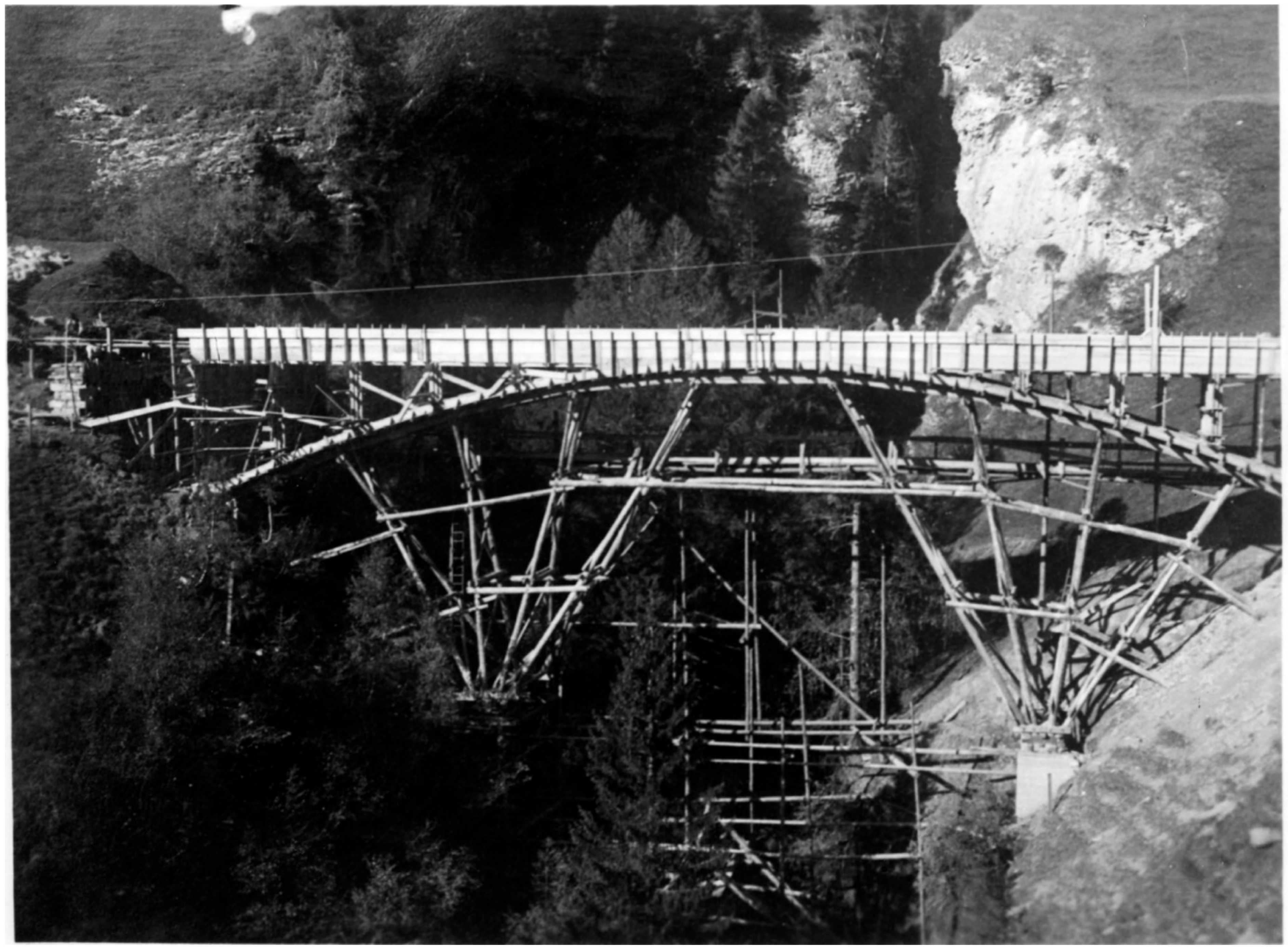
The result (of Maillart's assumptions) is a uniformly loaded arch with axial forces only and a nonuniformely loaded deck with bending forces only.

Maillart's simple method of analysis fit not just some of his deck-stiffened forms but all of them, because that analysis merely demonstrated what Maillart wanted to express physically
- that the arch should be as thin as possible.

- David P. Billington: Robert Maillart's Bridges; The Art of Engineering

Robert Maillart

the concept of the deck-stiffened arch (l'arc raidi)



Val Tschiel Bridge, scaffolding, 1925

All aspects of his dimensioning centered on those goals of lighter scaffolding, minimum materials, maximum integration of all structural members, acceptable behavior under full-scale testing, and the permanence of the completed bridge.

- David P. Billington: Robert Maillart's Bridges; The Art of Engineering

Robert Maillart

structural sensibility

Arve Bridge, 56.0m, 1936

Maillart's ideas on analysis remained constant, while his ideas on design constantly evolved.

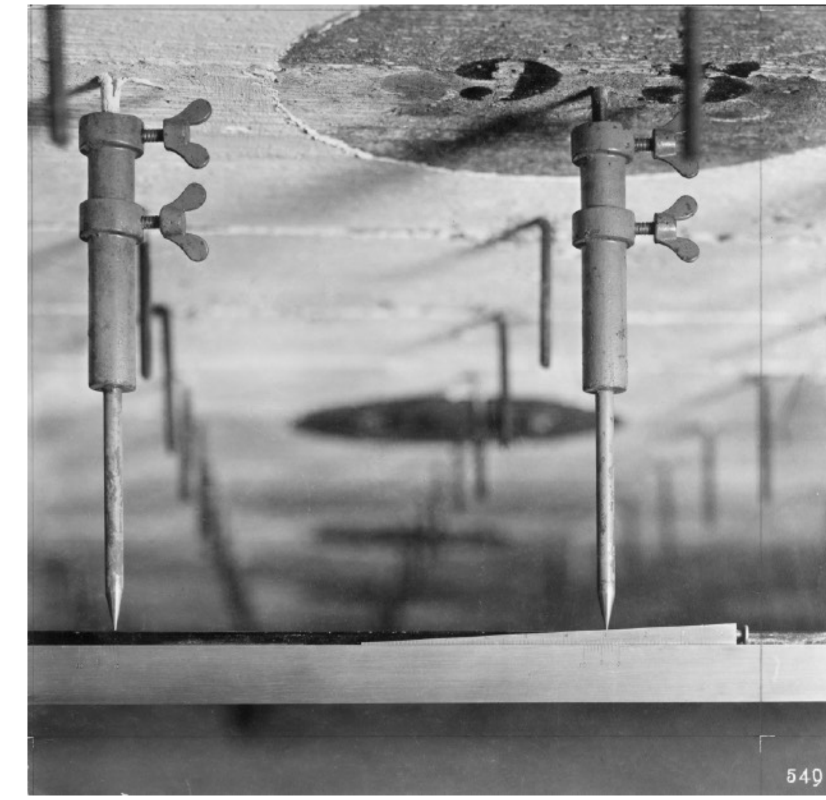
Maillart had a self-assurance about form that arose from familiarity with analysis, but that had been conditioned heavily by empirical evidence from ***constructed experience*** *and from* ***full scale testing****.*

- David P. Billington: Robert Maillart's Bridges; The Art of Engineering

Robert Maillart

structural sensibility

Maillart & Cie, Platten- und Balkenversuche, 1908



*Maillart's fundmental idea was that structure should be liberated from mathematical analysis; but, at the same time, it should be disciplined by the results of **physical testing** and visual **observation**.*

- David P. Billington: Robert Maillart's Bridges; The Art of Engineering

Robert Maillart

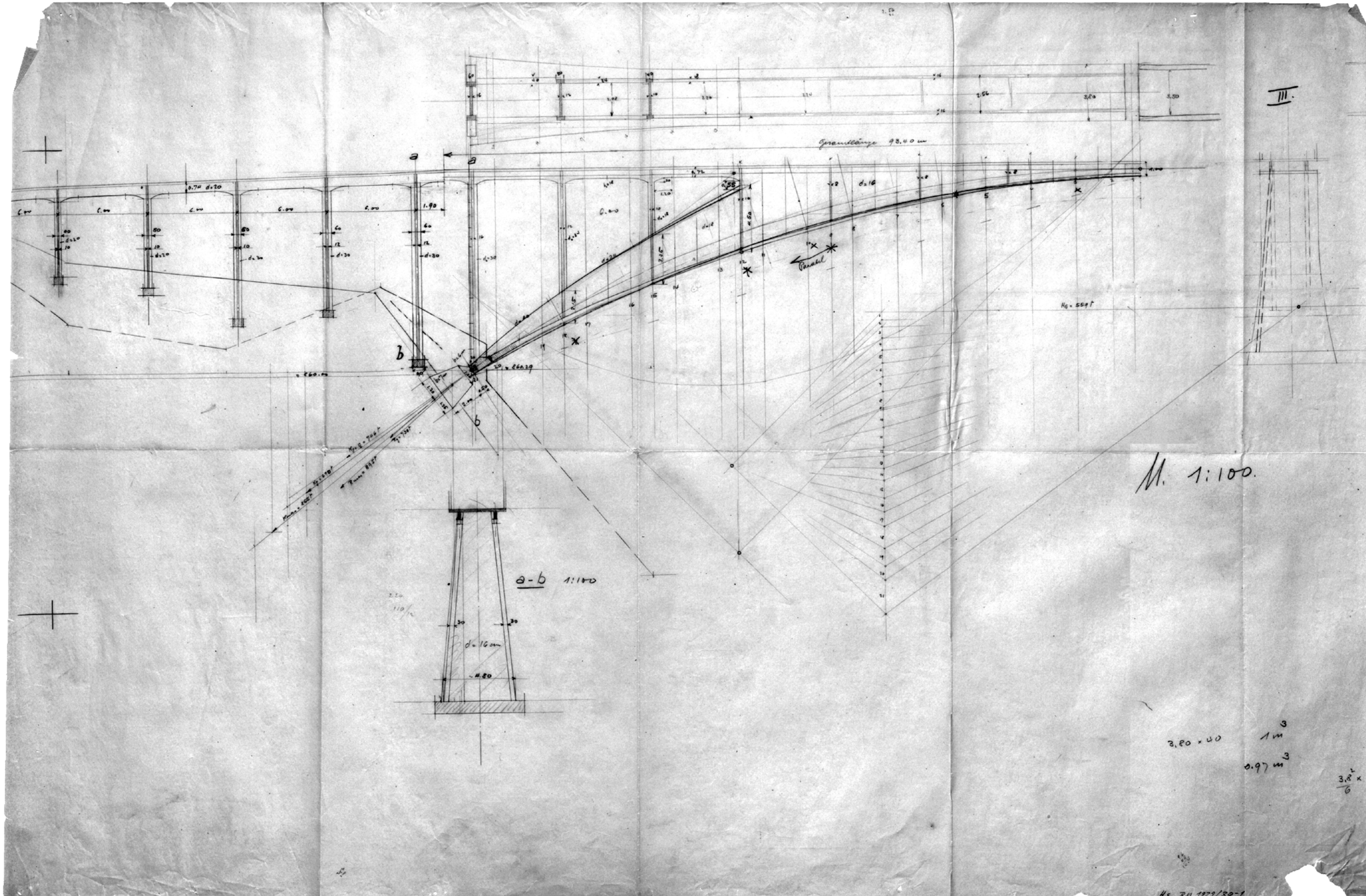
structural sensibility

The freedom to visualize form received its license form the record of tests and observations.

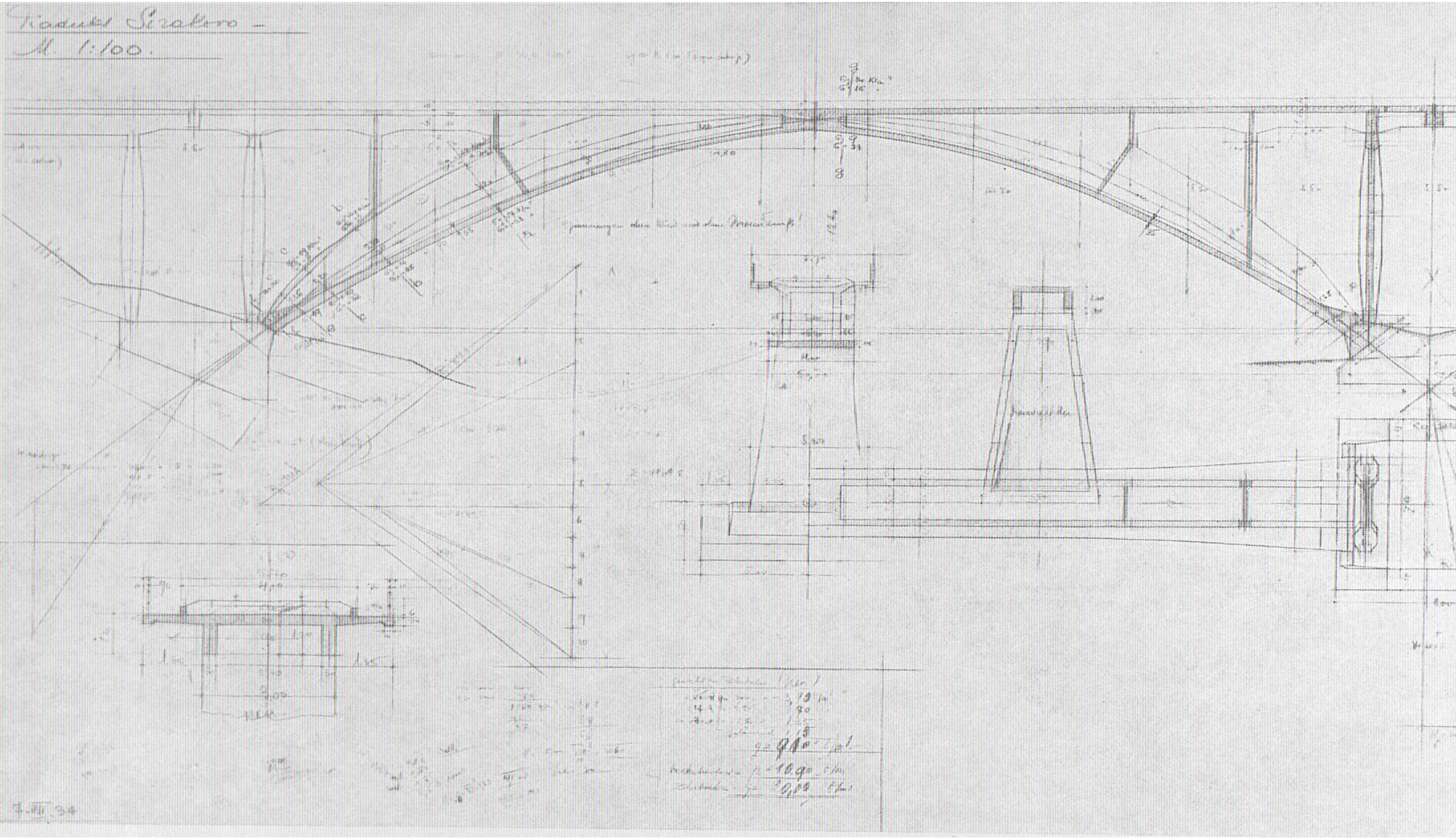
- David P. Billington: Robert Maillart's Bridges; The Art of Engineering

Maillart & Cie.,
Dampfzentrale in Barcelona, 1916-17 /
Sihlpost Zürich; 1929

Robert Maillart *drawing as design tool*



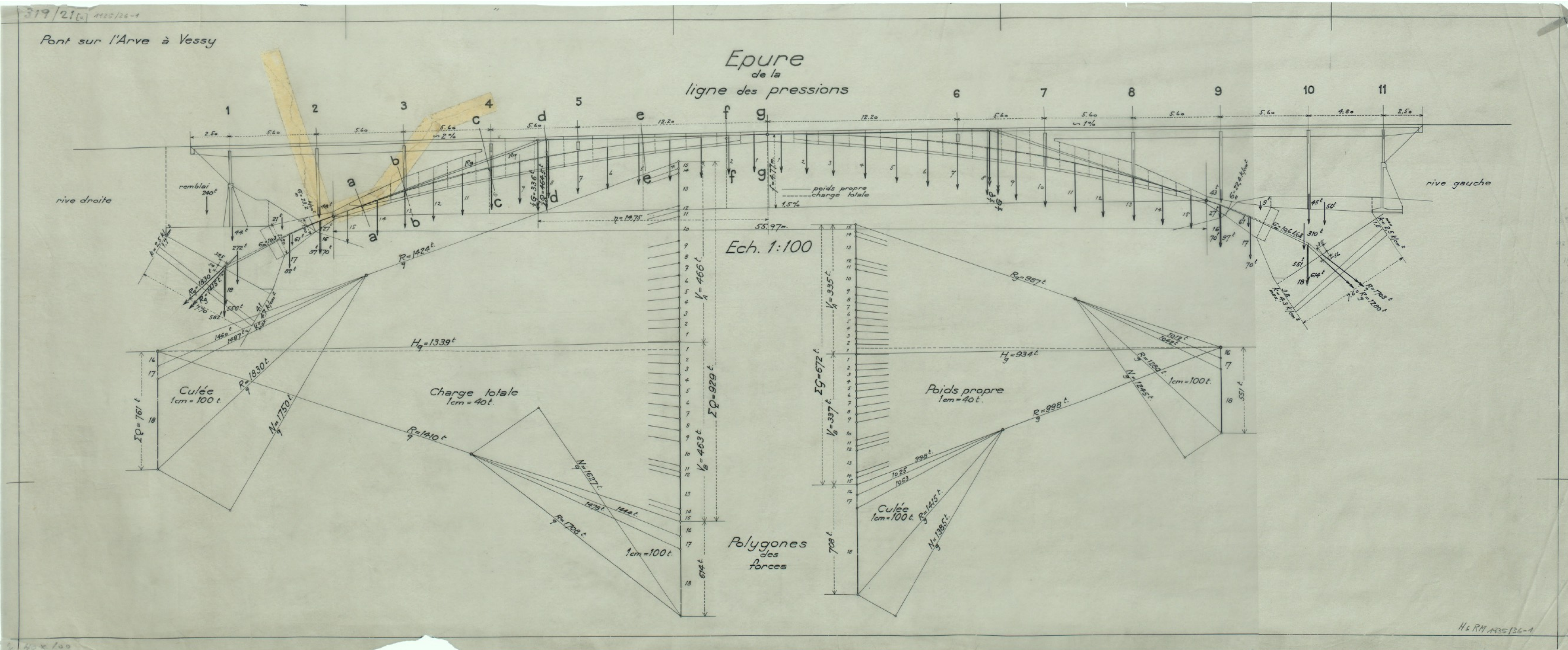
Salginatobel Bridge, 1930, process drawing



Maillart; Project for a railroad bridge in Yugoslavia, 1934, process drawing

Robert Maillart

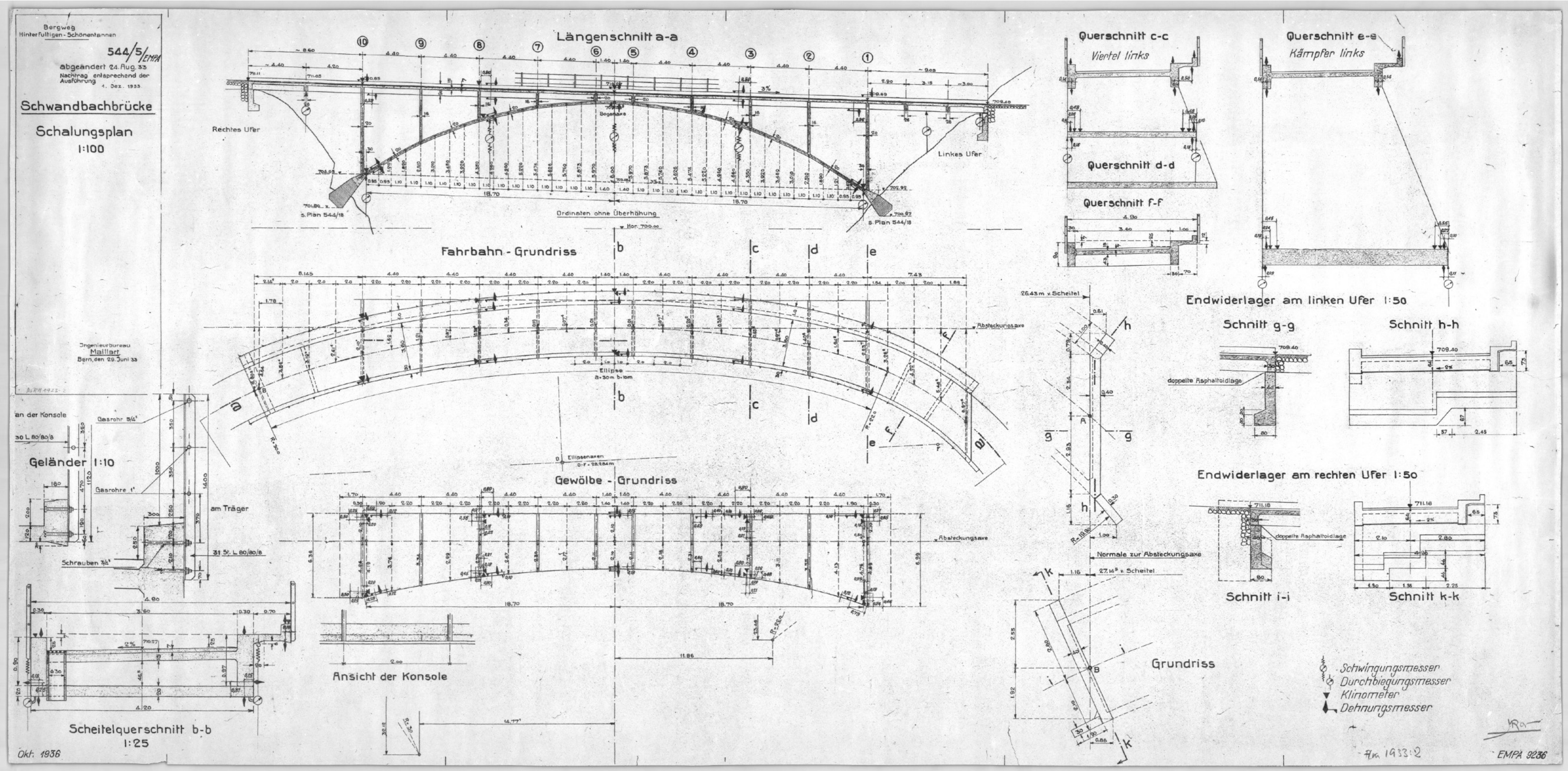
drawing as design tool



Arve Bridge, 1936, process drawing; ETH Bildarchiv

Robert Maillart

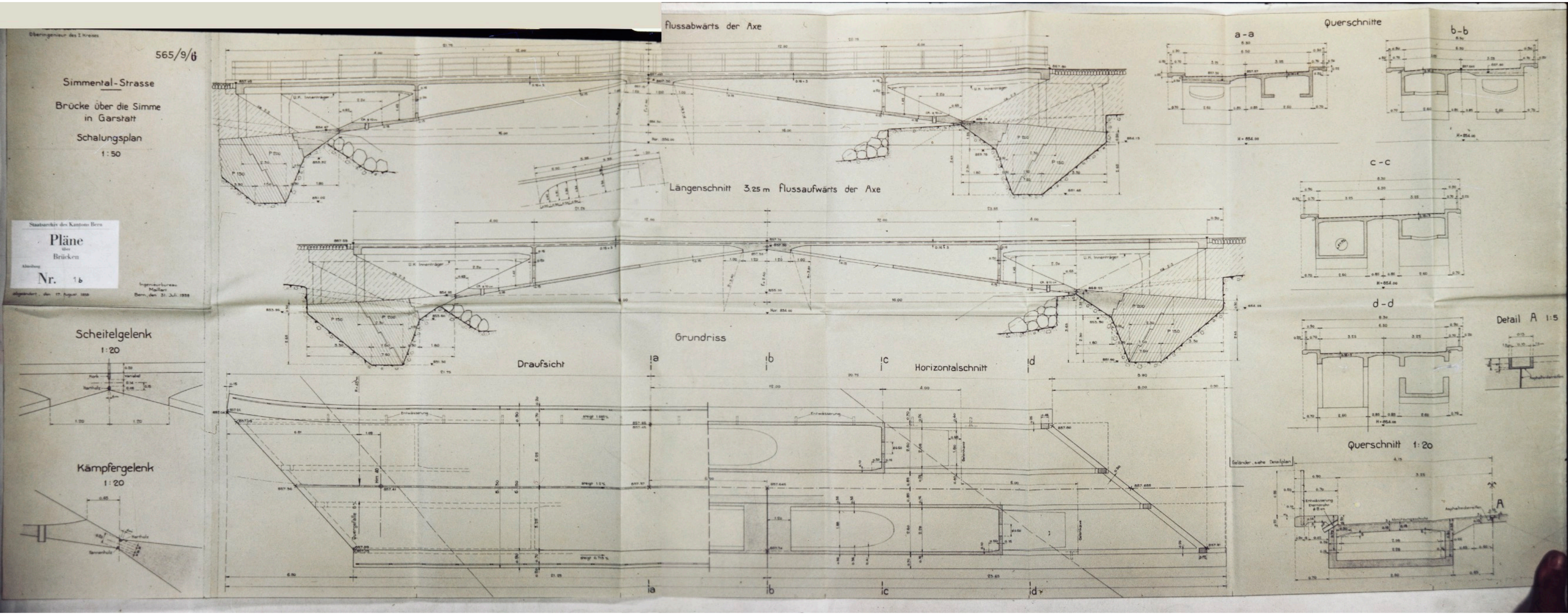
drawing for construction / drawing as construction



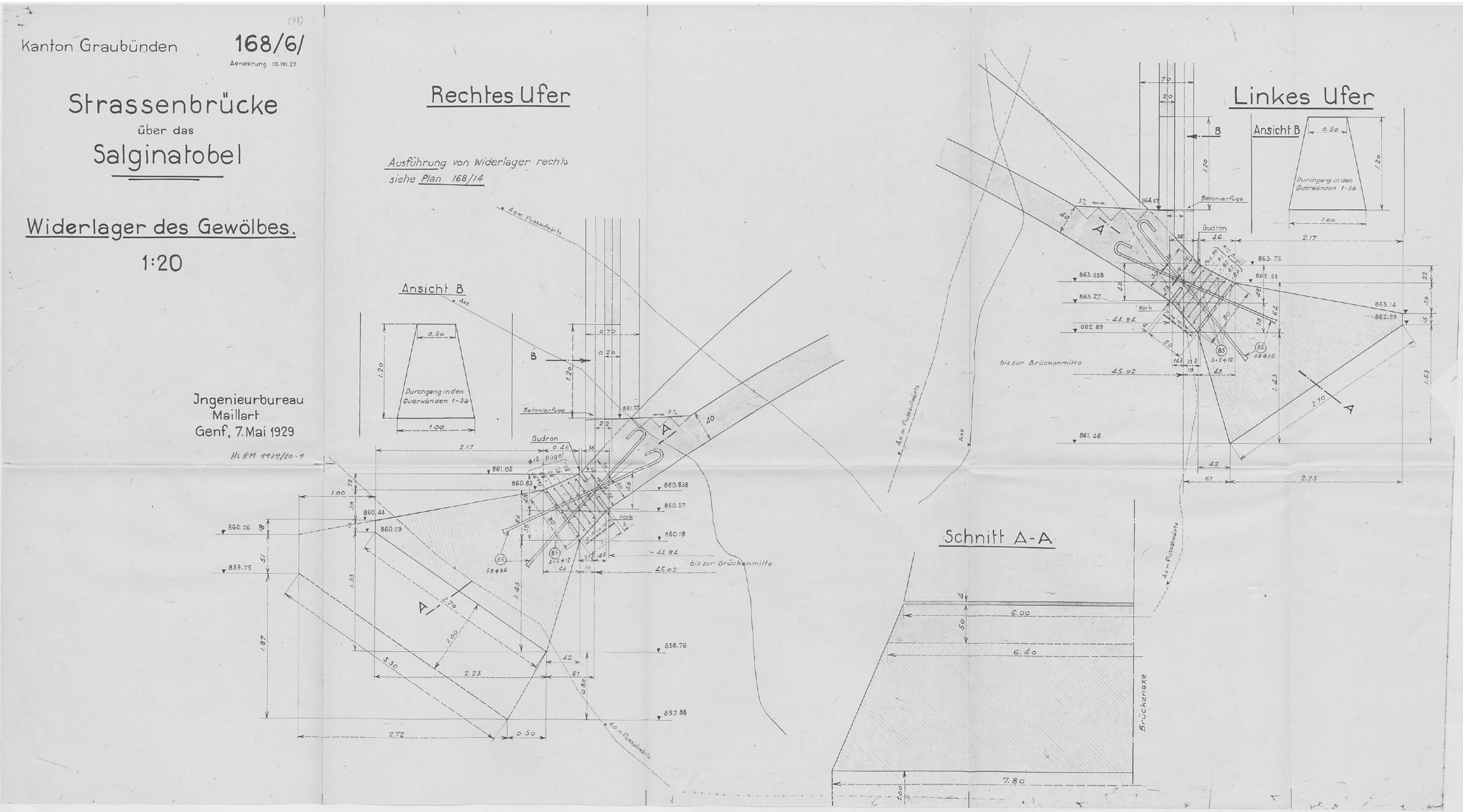
Schwandbach-Brücke, Hinterfultigen / Schönentannen, 1933; ETH Bildarchiv

Robert Maillart

drawing for construction / drawing as construction

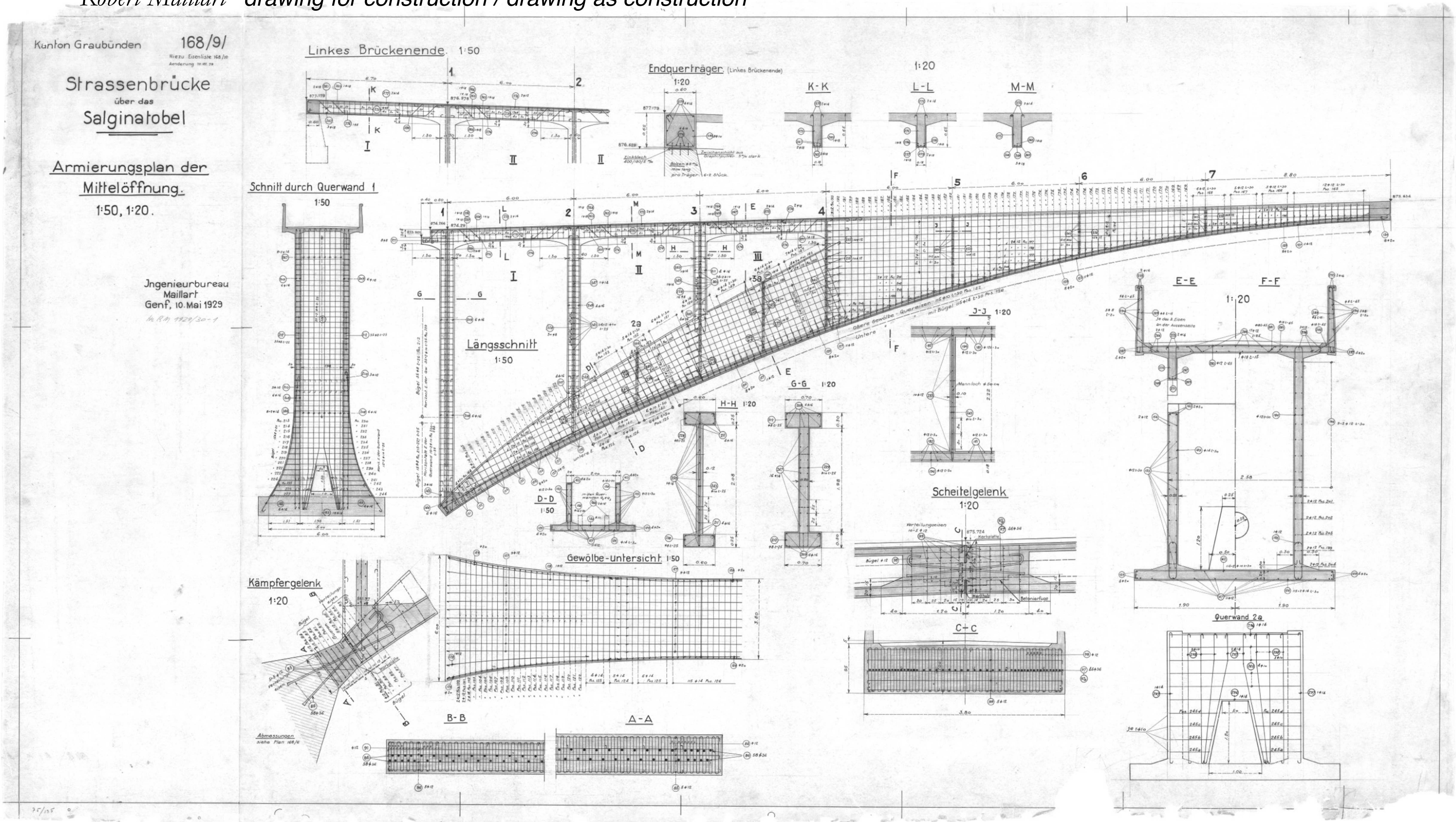


Brücke über die Simme, Garstatt, 1939/40; Staatsarchiv Kanton Bern



Salginatobel Bridge, 1930, drawing of articulations; ETH Bildarchiv

Robert Maillart ***drawing for construction / drawing as construction***



Salginatobel Bridge, 1930, drawing of reinforcement; ETH Bildarchiv

ETHZ Bildarchiv

https://ba.e-pics.ethz.ch/#main-search-text=maillart&main-search-mode=and

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