

HISTORICAL DEVELOPMENT OF PIER SCOUR HYDRAULICS

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Bridges are one of the classic engineering structures of which several have survived from the ancient times. Scour of bridge piers is one of the issues that may result in bridge failure. The causes of pier scour were investigated relatively late, because only laboratory observations indicated the complex scour pattern experienced in typical sand bed rivers. This work reviews the first century of bridge pier scour with a twofold approach: (1) Presentation of main papers, and (2) Introduction of the individuals behind the research. A total of twelve persons are presented, namely Durand-Claye, Engels, Kozeny, Keutner, Sackmann, Tison, Romita, Chabert, Engeldinger, Garde, Laursen and Neill. This Extended Abstract relates to three.

In almost one century, the major processes of pier scour were established using exclusively hydraulic models. However, no research was available to quantitatively determine pier scour geometry for a generalized approach flow and a certain pier geometry for particular sediment characteristics. Clearly, pier scour is a two-phase flow involving a complex flow process that requires a significant improvement of instrumentation. The researches accomplished from 1950 to 1970 have a much more fundamental character and thus responded to the urgent needs in establishing guidelines and thus allowing for an improved management of bridge piers.

Almost rectangular-shaped piers were obliquely inserted in a sediment bed by Romita (1953) to investigate the scour surface, along with the maximum scour depth. The work is accompanied with photographs illustrating the optical results. Also, the temporal development of maximum scour depth was investigated. A simplified computational appreciation for the causes of scour was given.



Fig. 1 Pier Luigi Romita (1924-2003), Jacques Chabert (1923-1968) and Pierre Engeldinger (born 1928)

Pier Luigi ROMITA was born on July 27, 1924 in Torino, Italy. He graduated in 1947 as a civil engineer from Rome University and in 1952 submitted the previously discussed PhD thesis to the Politecnico of Milan. From 1956, he was there a staff member of the Agricultural Faculty and was appointed professor of agricultural hydraulics there in 1964 until retirement in 1996. Romita took also interest in hydropower schemes and there contributed papers on the roughness of penstocks, and on the run-up of solitary waves onto permeable barriers. From the 1960s, Romita contributed to agricultural hydraulics and presented papers on questions in seepage, and irrigation and drainage. He passed away on March 23, 2003 in Milan.

The largest experimental study on bridge piers was conducted by Chabert and Engeldinger (1956) at *Laboratoire National d'Hydraulique* in Chatou. The experimental study involves hundreds of pier scour observations. Various channels served for the research along with a number of both uniform and non-uniform sediments and dozens of pier shapes. The temporal advance of maximum scour depth was observed. However, due to other projects, the analysis of these experiments was never conducted, such that this work is (still) a precious source of experimental data. Few data series have up to now been re-analyzed, although it is known that modern computational approaches would find here an impressive observational source.

Jacques CHABERT was born in Lille, France, on November 23, 1923. After graduation as a civil engineer from *Ecole des Ponts et Chaussées*, he entered the newly founded *Electricité de France* EDF and became a collaborator of its National Hydraulics Laboratory. From the beginning, Chabert was interested in fluvial processes. After publication of the report mentioned, he contributed to practical questions of Rhone River. After having directed the Fluvial Department of the Laboratory, he there took over as Director in 1963. In parallel he was a Lecturer at *Ecole des Ponts et Chaussées* and a hydraulics professor at *Ecole Speciale des Travaux Publics*, both located in Paris. Chabert passed away at a young age on July 30, 1968 in Chatou, France.

Pierre ENGELDINGER was born on January 31, 1928 in Dijon, France. He graduated as an engineer from *Ecole Centrale* in Paris in 1951 and then joined the *Laboratoire National d'Hydraulique* in Chatou, where he was a collaborator of Jacques Chabert and with whom he conducted the pier scour research. From 1956, once the report was published, Engeldinger stayed for three years in Brazil at the hydraulic laboratories of *Porto Alegre* and Sao Paulo, to return in 1960 to Chatou Laboratory. From 1962, he was attached to the presidency of *Electricité de France* EDF and there was mainly involved in the power distribution department. Engeldinger retired in 1992 and currently lives in *Vaucresson*, France.

REFERENCES

- Chabert, J., Engeldinger, P. (1956). *Etude des affouillements autour des piles de ponts* (Study on scour around bridge piers). Laboratoire National d'Hydraulique: Chatou.
- Romita, P.L. (1953). Erosioni d'alveo al piede delle pile di ponte investite obliquamente dalla corrente (Fluvial erosion of bridge piers aligned obliquely in the current). *L'Energia Elettrica* 30(4): 211-224.