Physical Hydraulic models past and present

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FOREWORD

It's a well-known fact that fluid mechanics and hydraulics with it are the branches of physics where the experimental approach in the research had the greatest development. Although the reasons are known: in the equations of fluid mechanics non linear terms often appear that can not be neglected, the differential equations are complex and can be integrated only in some simple cases, the contours of the phenomena under study are very articulated and complex, making even more difficult to solve them analytically. The proof of these difficulties can be found in the old texts on hydraulics, in the first half of the twentieth century, which were the only textbooks for engineers who showed numerical or graphical methods to solve many problems: the fluctuations in the surge tanks, water hammer pressures, the free level profiles of gradually varied flow in channels are only perhaps the most famous cases, even then solved with numerical methods. The interest in the experimental approach in the research derives exactly from the said difficulties of the analytical method and this also explains the great development of hydraulic research laboratories, which reached in some cases large dimensions.

During the same period of the last century were developed in the Dimensional Analysis and the Theory of Similarity, which allowed the correct setting and developing of the various particular researches.

And when it was necessary to examine the behaviour of a great and expensive work with important interferences with the territory, it was logic to build an experimental equipment dedicated to that work, which ultimately was indicated as the "hydraulic model" of that work. The word "model" is borrowed from architecture and is as old as it is directly derived from the Latin word "modellus" which is short for "modus" meaning "measure". In the old days, when an architect wanted to illustrate his new idea was building a good reproduction in three dimensions on a smaller scale of the of the new work. On the other hand, the hydraulic model, as discussed below, must respect the geometric similarity and the final result is very similar to an architectural model.

For several decades, the hydraulic model was the most powerful means of control of major projects, also enjoying a high esteem by the most experienced researchers in hydraulic, so that the legislation of many countries foresaw mandatory controlling major projects with the physical model. And no doubt that the research that accompanied the hydraulic model was very significant: as proven by the scientific production on this topic, important and large, at least for the time.

The unchallenged power of the physical model did not have a long duration, let say fifty-sixty years, since starting in about 1960 the successful life of computing machines began and they gave great impetus to numerical methods for solving complex calculations. It was natural to think of a specific numerical program for predicting the behaviour of a single work, which was called by analogy "mathemat-