Problems of modellizzation and analysis limit of the constructions in masonry
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The major sensibility towards the conservation of the existing, building and monumental patrimony architectonic, has carried recently to a renewed interest towards the study of the building behaviour, stimulating the search in directions specific of investigation that have legitimate to leave from the pioneering ones suggestions of Castigliano, the resource to the numerical modelation, based on effective methods of calculation, like methodology F.E.M. The result of such searches they have been object of several scientific publications and have constituted the base for the drawing up of the present thesis.

The thesis has been articulated in three parts, in before is introduced the relative theory to the mechanics of masonry. The major part of the arguments dealt here, makes reference the elastic theory and is:
- mechanics of collapse for compression (H.K. Hilsdorf);
- theoretical analysis on the phenomenon of instability (J.C. Chapman, J. Stalford);
- mechanics of collapse for cut-compression (V. Tursenk, F. Cacovic);
- theory of analysis limit (Druker-Prager, Heyman).

The arguments dealt in the second part, make instead reference the application of methodology F.E.M. for the study of the building behaviour, that lead the problem in the field of the numerical calculation, the solution is obtained in such a way, through the elaboration of a system of linear algebrich equations, assuming an approximate model of continuous schematizzation of like entirety finite of elements. In the applied the method of finite elements (F.E.M.), for the study of the structures in masonry, can be follow numerous procedures, but all leading back to two roads complementary alternatives and that are constituted on one side, from the solid modellazione of building like discontinuous, heterogeneous means and directional not the reagent to traction, oppose as half continuous but also always not homogenous.

The scope of third and last part of the thesis, consists in putting in practical one of the techniques of analysis F.E.M. applied to masonries and verifing the validity through the theory of analysis limit. The object of analysis to which reference has been made is the Mosca's Bridge, planned from Carlo Bernardo Mosca in 1818-23 and constructed in the successive years over the Dora in Turin, is the lowered arc bridge in stone, represented sure, as it has been unanimously recognised, a work of vanguard and, al same time, a point of arrival in the history of the construction of the bridges in stone.
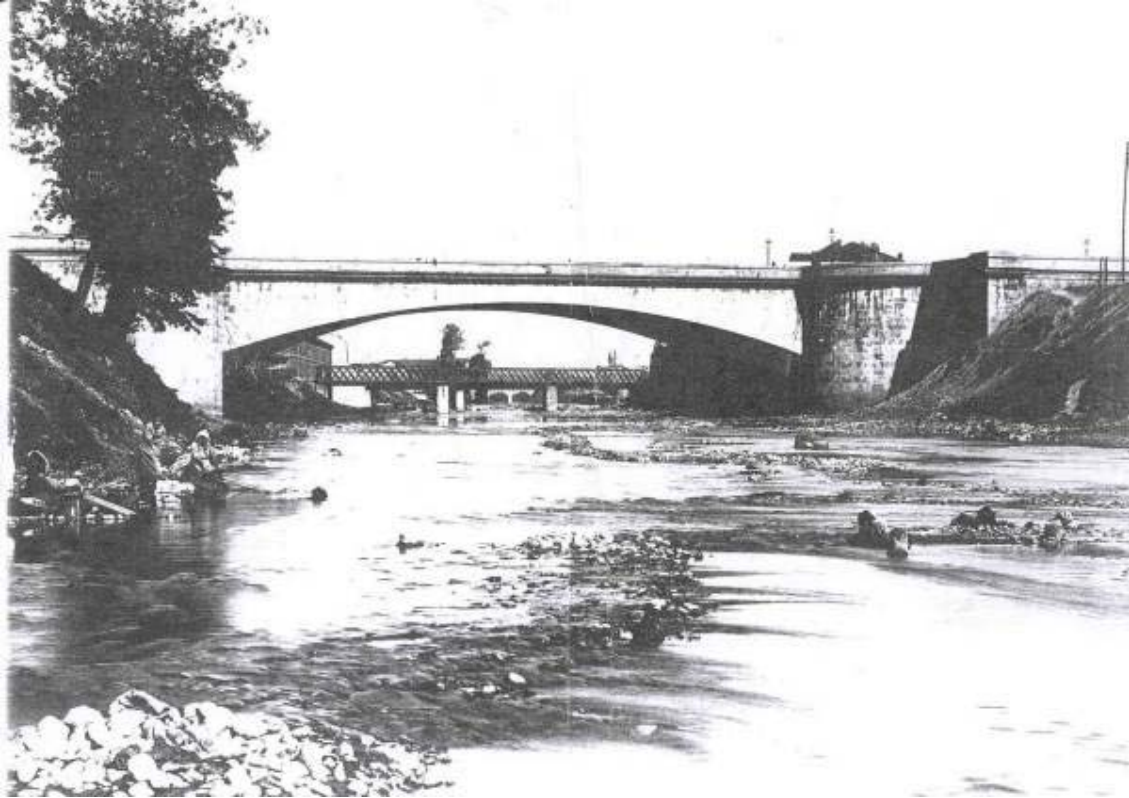
Mosca's bridge, Turin

For the definition of the mathematical model to Finite Elements, being the bridge in issue constituted from a structure to blocks, it has been assumed that the potential sections of crisis they are manifested in the joints of contact between the same blocks, for which modellazione FEM it has been executed reproducing the voussoir in stone with elements SHELL, while in order to simulate the unilateral contact mortar-stone, has adopted the finite element GAP. These last ones have been exactly decided in correspondence of the beds of mortar, between voussoir and voussoir.
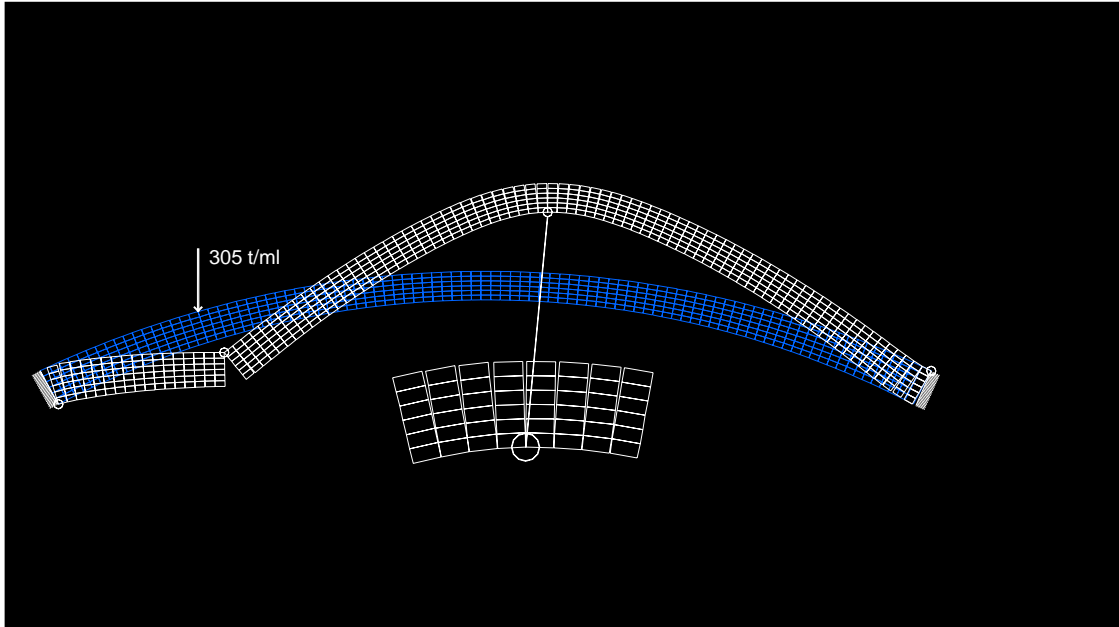
F.E.M. Model with deformation of arch at collapse (amplification factor: 20)

For last a model of calculation simplified, implemented on electronic sheet has been put to point, in order to estimate the multipliers of collapse of last loads, making reference the cinematic theorem of the theory of the plasticity, in agreement with the simplify hypotheses formulated from Heyman, in order to adapt the analysis limit to the structures not reagents to traction.

Beginning from these tasks, operatingly have been estimated the incognito value of the concentrated cargo that, place in one determined position (initially to ¼ of the span) and agent directly at extrados of arch, originates a hypothetical cinematism to four hinges. The minimal value found, it determines the position of the real mechanism of collapse. Through this procedure analytics much simple one, has been possible to verify the validity of method FEM, than would otherwise not have been possible to verify.
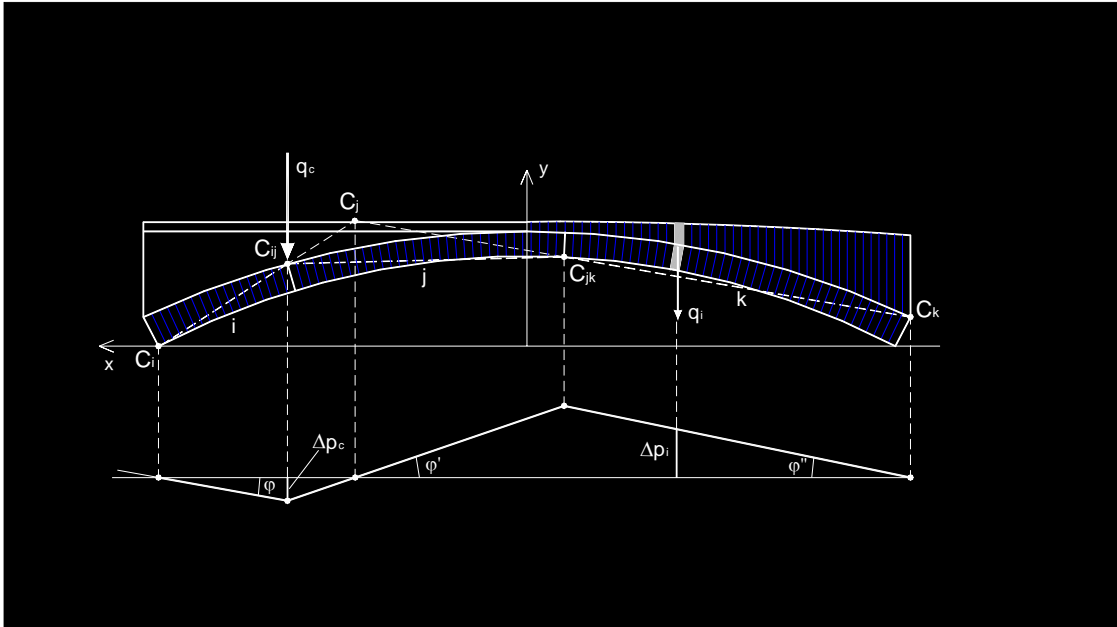
Virtual displacements for the collapse mechanism

An ulterior deepening of the application of analysis limit, it has been lead introducing the effect of plasticizzation of the material in correspondence of the compressed part that it is generated in the formation of the opening hinges, making reference in first approximation to a behaviour of the material elastic perfectly plastic, and to one rectangular distribution of the tensions, in agreement to the jobs introduced from Crisfield (1987).

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