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The Knowledge of a Three Arched Stone Bridge in the Alpine Region Based on the Comparison between Historical Analysis and Diagnostic Data

Ganda Bridge at Morbegno is placed in the north of Italy, across the Adda river, about 165 km upstream the Como Lake, in the very heart of the Alpine Chain. The original bridge was built during the Renaissance by the famous architect Johanne Antonio Amadeo, chief engineer of the Duke of Milan. Anyway during its lifetime the bridge was damaged by numerous river floods and war episodes, until in 1772 it was definitively strongly damaged by a river flood and consequently it was necessary its complete reconstruction. At Ambrosiana Library in Milan are filed a lot of documents dealing with this work of reconstruction, allowing a detailed knowledge of the design specification of a bridge construction work dated during the late XVIII sec.

Recently a careful inspection was carried on the bridge with the purpose of assessing its structural conditions. The geometric survey, that allowed also the detection of crack and deformation pattern, was made with laser-scanner. The ability of operating by access and position techniques by ropes furthermore allowed the execution of a close visual analysis of the state of conservation of the structures. The diagnostic on site tests were then performed both by NDT (ultrasonic tomography) and slightly destructive methods (coring and video-inspection).

It was therefore possible to acquire a lot of information about geometry, materials and construction techniques; they were then matched with the historical ones, thus pointing out similarities and differences between the original design specifications and the actually built bridge, both in geometry (the piles) and construction (the foundations). Some aspects relevant for the structural behaviour were also pointed out, such as the continuous cracks at the intrados of the arches and the apparent weakness of the foundations.

Finally a numerical analysis was carried out by F.E.M. to allow the determination of the maximum allowable load that can pass above the bridge and to valuate the behaviour of the structure under seismic loads.

keywords: bridge, non destructive test, construction techniques, structural assessment