

# Safety assessment of existing post-war reinforced concrete bridges. The case study of ‘Gerber girders’ bridges in Italy

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## ABSTRACT

In Europe, during the 1950s and 1970s the wide development of roads and highways network lead to the fast construction of a wide stock of reinforced concrete bridges. Alongside the development of the typology of the arch bridge, that in those years reached impressive spans, girders bridges were supported by the evolution, from the 1950s onwards, of the pre-stressing technique [1]. Regarding girders bridges, in Italy, one of the most established static typology was the statically determinate “Gerber girders” bridge: easy to calculate and economic in construction, this bridge typology was diffused all over the country road network. Building code and calculation methods of the time led to reinforcements arrangement solutions that, today following the calculation theory evolution, are considered improper for the actual structural task [2]: as a consequence, the whole stock of existing Gerber truss bridge of Italian road network exhibit insufficient performance in terms of structural safety and represent an urgent task for performance analysis and retrofitting design.

In this framework, the proposed paper presents a novel cross-disciplinary procedure for the performance analysis. According to the actual flowchart in the assessment analysis, composed of the two steps of the “knowledge phase” and the “analysis phase”, the proposed procedure is based on three concatenated actions: archival research and construction history based surveys, oriented *in situ* survey, tailored safety assessments. As a consequence, the acquired historical and technical knowledge of the original design, the building code of the time and the adopted construction process supports the *in situ* surveys and the tailored safety assessments. The construction history surveys allowed, indeed, to enable, through the archival research, a wide set of data that are still overlooked in the standard adopted assessment analysis procedure [3]. Crossing the information of calculation reports, with time building code references, reinforcements detailed drawings, construction-site pictures, reports on load tests and test on employed building materials, a solid base technical knowledge of the work could be achieved and completed through oriented cost and time effective *in situ* surveys.

Given this point of departure, the presented paper is structured as follows: in the first part an exemplar series of bridge typologies, built between 1950s and 1970s, with different construction process and are presented; in the second part related historical sources data typologies (i.e. archival documents, building code extract) are presented and discussed; in the third part the whole procedure is presented applied to a selected work and, in conclusions, results are discussed with future research perspectives. Concluding, if, as declared in 2010, “*the assessment of existing structures is now a major engineering task*” [4], the present paper aim to boost a cost-effective, and sustainable, alternative to the replacement of the existing structure, fostering their safe use. Furthermore, the data crossing of the historical documentation with the *in situ* surveys could lead, even, to improve significantly knowledge in the history of construction techniques, opening novel cross-disciplinary perspective on the valorisation of 20<sup>th</sup> century infrastructural heritage.

## REFERENCES

- [1] Rinaldi, G., Ponti e viadotti: rapporto, Realizzazioni in cemento armato precompresso, V FIP, pp. 5-35, (1966).
- [2] CNR, 10037/86, Bollettino Tecnico, Mensole Tozze e selle Gerber, (1992).
- [3] Modena, C., Tecchio, G., Pellegrino, C., da Porto, F., Zanini, M. A., & Donà, M.. Retrofitting and refurbishment of existing road bridges. Maintenance and safety of aging infrastructure, 469-533, (2014).
- [4] ISO 13822, Bases for design of structures - Assessment of existing structures, (2010)