Design Challenges of Bridge Falsework Structures

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The present paper concerns bridge falsework structures, highlighting the current challenges associated with their design and giving indications of how they can be considered.

Despite being the most critical stage of a structures' lifetime – most failures occur during construction rather than after projects have been completed – the design and use of temporary structures are not usually treated as carefully as in the case of permanent structures, and thus do not receive the same level of research attention and research funding. This is clearly evidenced by the number and the state-of-the-art level of existing standards and guidance documents concerning permanent structures as opposed to temporary structures, such as bridge falsework structures.

Therefore, there are difficult challenges in their design when compared with the design of permanent structures, for instance:

Generally, the design of bridge falsework structures is controlled by the self weight of the permanent structure, by second order effects resulting from displacements in the temporary structure, or by the changement of their supporting conditions, in the case of movable falsework systems, during the construction of the permanent structure. As a result, these temporary structures are subject to load values close, or even above, the assumed design values during almost their entire service period, whereas permanent structures are designed for load values that have a small probability of occurring during their design lifetime;

Bridge falsework structures are used for brief periods of time, although their sum could represent 15 years or more. Some design philosophies, based on the temporary nature of these structures, specify smaller safety factors than the ones used in the design of permanent structures. However, since the ratio between their cost and the cost associated with their collapse is much lower than for permanent structures, this methodology needs to be reconsidered using a risk-based approach. Furthermore, the use of smaller safety factors may underestimate the loads and lead to unsafe structures;

Bridge falsework structures are assembled, (re)used for short periods and dismantled several times. Additionally, erection, inspection and maintenance procedures are often found to be inadequate. As a result, construction errors are likely to occur, i.e. the human factor is always present with potential severe consequences. Permanent structures are currently assembled only once and used for large periods of time and they exhibit a much higher degree of inherent robustness against human errors;

Due to their repeated reuse , bridge falsework structures face during their design period several different exposure conditions to various hazard scenarios in a number far greater than any permanent structure needs to be designed against;

Finally, bridge falsework structures due to their purpose are generally light and slender structures, and therefore their performance is more sensible than permanent structures to errors during their erection and use, and to inadequate maintenance and quality control,.

These challenges are often found to be not completely addressed in existing codes. Additionally, the demand for more rational, cost-efficient and safer structures is increasing the importance of reliability, robustness, and risk matters. The present paper will present arguments to extent this trend to the design of bridge falsework structures.