Implementation of Bayesian Updating for Service Life Assessment of Concrete Structures – Phase 1

Major bridge projects require that new structures be designed for a target service life typically in the range of 75 years to 125 years. To perform the service life design of concrete structures, COWI implements a full probabilistic methodology based on the fib Bulletin 34 approach to design concrete structures for chloride-induced corrosion.

Once the structure is in service, the questions become: Will the structure achieve the target service life? What is the structure's remaining service life?

These questions become particularly important for projects where a private company is responsible for the operation and maintenance of the asset over a long-term concession period (typically 25 to 35 years). Many contracts include a requirement for the structure to have a specified remaining service life at the handback date. The challenge for both parties is to determine if, at the handback date, the structure meets this remaining service life criteria.

Generally, a deterministic approach is used to assess remaining service life. This deterministic analysis may not consider assumptions made during the design stage and information gathered during and after the construction stage.

A probabilistic method can be used to update the service life modelling made during the design phase by implementing the principles of Bayesian Updating. Bayesian Updating is a mathematical theory used to improve (or update) a prior probability estimate to produce a posterior probability estimate as new data is acquired. Some specialized consulting engineering firms are starting to implement this method to assess the remaining service life of concrete structures.

The objective of this project is to develop a methodology that could use to assess the remaining service life of concrete structures using the principles of Bayesian Updating. The development of this methodology would enable consultants to assess the durability of concrete structures at all stages of their life cycle using a full probabilistic approach.

To achieve this objective, the project is broken down into phases with the outcome of each phase serving as a foundation for the next. The present COWIfonden application is for the first phase only: the objective of the first phase is to assess the current state-of-the-art knowledge and develop the framework for a methodology to assess the remaining service life of a structure. Based on an initial literature review, the team is confident that there is enough information available to achieve its objective.