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Abstract: We combine Bayesian networks (BNs) and structural reliability methods (SRMs) to create a new computational framework, termed enhanced BN (eBN), for reliability and risk analysis of engineering structures and infrastructure. BNs are efficient in representing and evaluating complex probabilistic dependence structures, as present in infrastructure and structural systems, and they facilitate Bayesian updating of the model when new information becomes available. On the other hand, SRMs enable accurate assessment of probabilities of rare events represented by computationally demanding physically based models. By combining the two methods, the eBN framework provides a unified and powerful tool for efficiently computing probabilities of rare events in complex structural and infrastructure systems in which information evolves in time. Strategies for modeling and efficiently analyzing the eBN are described by way of several conceptual examples. The companion paper applies the eBN methodology to example structural and infrastructure systems. Read More: http://ascelibrary.org/doi/abs/10.1061/%28ASCE%29EM.1943-7889.0000173

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