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Probability of fatigue failure in brick masonry under compressive loading

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ABSTRACT

Long-term fatigue tests under compressive loading were performed on low-strength brick masonry prisms under laboratory conditions. The number of loading cycles to failure were recorded and used to investigate the suitability of the logarithmic normal distribution to describe fatigue test data and to develop a probability based mathematical expression for the prediction of the fatigue life of masonry. The proposed model incorporates the applied maximum stress level, stress range, number of loading cycles and probability of survival. From the mathematical model a set of curves for stress level - cycles to failure - probability of survival (S-N-P) were identified to allow the fatigue life of masonry to be predicted for any desired confidence level. Upper limit, lower limit and mean curves were proposed. The prediction curves were compared with the test data and proposed expressions from the literature and proved to be suitable to predict the fatigue life of masonry. It is surmised that S-N-P curves provide a useful tool to help evaluate the remaining service life of masonry arch bridges at different confidence levels, based on material properties. The proposed mathematical model can be incorporated into existing assessment methodologies, such as SMART to quantify the residual life of brick masonry arch bridges for failure modes associated with compressive loading.

Keywords: Brick Masonry, Fatigue, S-N curve, Probability