TOWARDS RELIABILITY BASED MAINTENANCE STRATEGY OF AGEING BRIDGES

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In recent years, there has been significant progress in the structural reliability theory related performance evaluation of engineering structures including bridges. This paper presents how structural reliability theory can be used in condition estimation and maintenance of different bridges. Like every other structures, bridges deteriorate due to ageing effects. Depending on the type of bridge, failure modes are proposed considering critical failure modes of the bridge concerned as shown in Equation 1.

$$M_i = Z_{R_i} - Z_{S_i} \qquad i = 1, 2..., n \tag{1}$$

where, M_i is the safety margin for i^{th} mode of failure of the bridge concerned, Z_{R_i} is the strength variable and Z_{S_i} is the load variable. The reliability index (β_i) and failure probability (P_{f_i}) for i^{th} failure mode can be calculated as the first step. Assuming all failure modes are combined with a series system for the bridge concerned, it is possible to calculate the system failure probability (P_F) from simple bounds as shown in Equation 2.

$$\max_{i=1,2}^{n} P_{f_i} \le P_F \le 1 - \prod_{i=1}^{n} \left(1 - P_{f_i}\right) \tag{2}$$

Then,

$$\beta_S = -\phi^{-1}(P_F) \tag{3}$$

As in the Equation 3, for each type of bridge, it is possible to calculate the system reliability index (β_S) at different times. The reliability index reduces with time as in Figure 1.

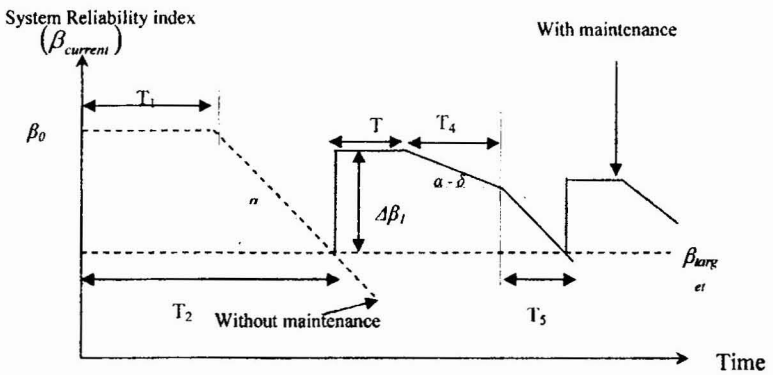

Figure 1. Variation of system reliability with time

Once it reaches the target reliability index (β_{target}), bridge maintenance can be carried out. This kind of methodology is useful for a developing country like Sri Lanka.

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