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RELIABILITY BASED SERVICE LIFE TIME ESTIMATION OF RIVETED WROUGHT IRON RAILWAY BRIDGES

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Over the last two decades, significant progress has been made in estimating of the remaining service lifetime of railway bridges. At present almost all the railway bridges in Sri Lanka are nearly 100 years old and are not in a satisfactory condition. Standard codes of practices do not provide enough information on estimation of remaining service lifetime. This paper presents the analysis of a riveted wrought iron railway bridge which was carried out as a case study. The analysis was based on a method of evaluation of the remaining service life using the theory of structural reliability which is primarily a probability based theory.

The bridge under consideration was 84 metres in length having eight spans of Warren type girders supported by cylindrical piers. In this type of bridges, the most critical structural failure mode is fatigue failure. A computer model was developed using SAP 2000 computer package and members liable to fatigue failure were identified. Furthermore, it was found that there were two sets of members, one set experiencing one stress cycle and the other experiencing two stress cycles when a train passes over.

Based on time schedules provided by the Sri Lanka Government Railways (SLGR), probabilistic parameters, mainly the mean and the variance of the number of stress cycles applied up to now were evaluated from the time of the particular bridge constructed up to the date with intermediate time periods. From laboratory testing probabilistic variation of the total number of cycles applicable up to the fatigue failure was also estimated. According to the theory, failure probability is evaluated through a parameter called reliability index (β). Reliability index can be estimated through means and variances of number of cycles applied and the total number of such cycles required to cause failure.

Having known the probabilistic variation of the number of stress cycles applied and the total number of cycles required to cause fatigue failure, the failure probability of the two sets of members was evaluated. Assuming the present rate of loading, speed, and frequencies the time required to reach the maximum allowable failure probability was also estimated.

Based on the above evaluation, it can be concluded that the first set of members can be in service for about another 15 years and the second set of members is only seemed to be satisfactory for about 7 more years. If regular maintenance is carried out the remaining service life of these members can be upgraded by 10 more years in each case.

In the present study, estimations were carried out considering the members separately. In future studies, correlations among members will be taken into account to obtain a more realistic estimation on service life of bridges.