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Project Title:	Probabilistic Analysis of Highway Bridge Loading Events
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Project Objectives & Goals:
This work aims to develop accurate and reliable statistical methodologies that can be used in assessing the characteristic static load effect that a bridge may undergo. These methods will then be of use in determining probabilistic dynamic amplification factors for trucks on bridges. It is also hoped that the methods developed can lead to a design methodology that will be used by consultants in assessing existing highway bridges.

Brief Description:
Weigh-In-Motion (WIM) data has been used to obtain the statistical distributions that characterise the traffic of the site under study. The distributions used are based on the work of previous researchers and are standardised, for example the Poisson distribution with parameter of average inter-vehicle distance is used to model the headway. Using Monte-Carlo simulation techniques (that rely heavily on random number generation) a population of trucks can be formed, the parameters of which closely match those of the site under study. This step is required as simulated periods can be as much as a year in length whilst WIM data may only be available for a week or so of traffic at the site. Generation of traffic files has been carried out for both uni- and bi-directional 2-lane bridges. Extensive mathematical consideration was given to the possibility that two trucks could occupy the same location in the same lane at a given instant. The generated traffic is then used to calculate the load effects caused for several influence lines of interest. The influence lines used have been both theoretical and measured. The value of the load effects is recorded, along with the constituent trucks and other pertinent information for further analysis.

The statistics used in this work has evolved considerably over the course of this work. Currently, the Generalised Extreme Value (GEV) distribution is fitted, using Maximum Likelihood Estimation in conjunction with Probability Weighted Moments, to the daily maximum recorded load effect. The more recent finding of this research is that in examining the effect of three truck events on the characteristic design value obtained, it was found that the two and three truck events do not meet the iid (independent & identically distributed) requirement of extreme value statistics and this accounted for some unusual observations. A mixed-mechanism model has been proposed that will account for the differing distributions of different loading events and is currently under implementation. Other findings include that most load effects exhibit Weibull-type tail behaviour indicating that load effects are generally bounded; three truck events should be included in analyses of short to medium span bridges loading events; this method used yields results far lower than code stipulated values and may thus be employed in bridge load assessment.

Potential for Application:
The immediate application of the project is in a more refined statistical analysis that yields lower characteristic load effects than bridges are currently assessed for. The implication is that many bridges may be saved from demolition or may only need reduced strengthening works carried out. The potential savings to countries with ageing bridge stocks are enormous. Further, the statistical methodologies derived may be of use in other fields such as wind speed analysis and rainfall analysis.