Renovation of the CBR Flexible Pavement Design Procedure

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Abstract

The U.S. Military (Army, Air Force and Navy) and Federal Aviation Administration (FAA) thickness design procedures for flexible airport pavements are based on the CBR (California Bearing Ratio) method. This method was originally developed in the 1940's for design of flexible pavements to support the then new heavy bombers. The original airfield design curves were an extrapolation, based on shear stress, of the California pavement design curves for highway pavements. The extrapolated curves were modified and verified by extensive full scale field testing. In 1955 the classical CBR equation, $t = \sqrt{\frac{ESWL}{8.1 \cdot CBR} - \frac{A}{\pi}}$, was introduced into the Corps of Engineers CBR design procedure. In the late 1960's and early 1970's as a result of extensive prototype testing with full-scale multi-wheel aircraft assemblies, the classic CBR equation was modified with the introduction of a thickness reduction factor (Alpha factor). The thickness reduction factor was to account for traffic volume and for better than expected performance from multi-wheel assemblies.

Although the CBR design procedure has been in use unchanged for design and evaluation of both military and civil airfield pavement since 1970, the basic mechanistic nature of the procedure has not been recognized, even by the developers of the procedure. Because of the lack of understanding of the criteria contained within the CBR procedure, the methodology has been unjustly criticized in recent years. By using Frohlich's stress concentration factors, the basic mechanistic foundation for the CBR equation can be explained and the performance criteria clearly identified. The performance criteria contained in the CBR procedure can be computed directly without resorting to the equivalent single-wheel load (ESWL) concept. These criteria were recalibrated to available prototype test data, resulting in new design criteria without resorting to thickness adjustment factors. Since the new criteria represents a major change in the CBR design methodology, new proto-type pavement sections are being constructed that directly related to the new design methodology. As developed, the design criteria are very similar and can be directly related to the vertical strain criteria in use by the Corps of Engineers and FAA. Because of the improved predictive capability of the new criteria, the new CBR design methodology is being adopted by the military for design and evaluation of flexible pavements.

In the near future, the classic CBR equation will be replaced with the new criteria and the CBR procedure as it is now known will no longer exist. The new design procedure is considered to be a major advancement in pavement design technology and will result in a simple and easy to apply design methodology. The paper will explain the development of the classical CBR equation and will identify the performance criteria and mechanistic nature contained in the current CBR design procedure. The development and application of the new criteria will be presented in detail as well as comparisons of the criteria with other design criteria. The new renovated CBR design procedure will be presented along with the benefits that will be gained

over the old CBR design procedure and the importance the new procedure has on future military pavement design and evaluations.

Paper

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