Advanced Modeling and Design Methodology for Pavements using Plasticity-Based Shakedown Theory Dataset

Dataset available at: https://digitalcommons.lsu.edu/transet_data/85/

(This dataset supports report **Advanced Modeling and Design Methodology for Pavements Using Plasticity-Based Shakedown Theory**)

This U.S. Department of Transportation-funded dataset is preserved by the Transportation Consortium of South-Central States (TRAN-SET) in the LSU Digital Commons Repository (https://digitalcommons.lsu.edu), and is available at https://digitalcommons.lsu.edu/transet_data/85/

The related final report **Advanced Modeling and Design Methodology for Pavements Using Plasticity-Based Shakedown Theory**, is available from the National Transportation Library's Digital Repository at https://rosap.ntl.bts.gov/view/dot/56566

Metadata from the LSU Digital Commons Repository record:

Document Type: Data Set

Publication Date: 10-2020

Abstract: Pavement design is a process intended to find the most economical combination of layer thickness and material type for the pavement, taking into account the properties of the subgrade soil and the traffic to be carried during the service life of the road. The currently prevalent methods of pavement analysis and design, however, are more or less empirical in U.S., which possess the shortcoming that the important type of pavement distress of rutting related to the accumulation of plastic or permanent deformations cannot be effectively considered. This project proposes an exploratory study on the application of the plasticity theory-based shakedown concept to the analysis and design of pavements under repeated loading, with a more realistic incorporation of the roughness impact of the top pavement layer on the dynamic amplification of vehicle loading as well as on the elastic stress responses in the underlying subsoils. Numerical results from the newly developed vehicle-road coupling model show that the total vehicle load amplification factor ranges from 0.88 to 1.16 under different roughness levels and traveling speeds. This indicates the necessity and importance of incorporating the factors of roughness/vehicle speed in the pavement response analysis. Extensive parametric analyses for the shakedown limit show that increases in the pavement cohesion strength and internal friction angle and in the pavement thickness have a positive influence on the calculated shakedown limit value. The analysis results also indicate that there generally exists an optimal Young's modulus ratio between the pavement and subsoil, for which a maximum shakedown load of the pavement system will be reached. The outcomes of this project on one hand add contributions to the development of a more rational theoretical framework for the pavement design/analysis. On the other hand, the shakedown design approach can prevent the flexible pavement from excessive rutting failure, and hence is of great practical value for prediction/design of the vehicle load, traveling speed, and layer thickness that is required to warrant shakedown state of the pavements (i.e., no excessive rutting) in the long run.

Comments: Tran-SET Project: 19PLSU09

Recommended citation:
Chen, S., Sun, C., Wang, X., & Zhang, Z. (2020). Advanced Modeling and Design Methodology for Pavements using Plasticity-Based Shakedown Theory. Retrieved from https://digitalcommons.lsu.edu/transet_data/85

Dataset description:
This dataset contains 1 file collection described below.

Advanced Modeling and Design Methodology for Pavements Using Plasticity-Based Shakedown Theory Dataset.zip:

- No_name folder
  - No files
- Shakedowm_Analysis_and_Results
  - Shakedown Limit.xlsx
  - SD_for_Two_Layers_Stress.m
  - SD_for_Two_Layers.m
  - SD_for_Three_Layers_Stress.m
  - SD_fpr_Three_Layers.m
- Vehicle_road_analysis_code
  - wRec2.mat
  - wRec.mat
  - tightfig.m
  - Roughness.m
  - main.m
  - expression2DIntegral.m
  - expression1DIntegral.m

The .xlsx and .xls file types are Microsoft Excel files, which can be opened with Excel, and other free available software, such as OpenRefine.

File extension .m is associated with the Objective-C, a general-purpose, object-oriented programming language based on Smalltalk language developed by Apple, Inc (for more information on the .m file type and associated software, please visit https://www.file-extensions.org/m-file-extension).

The .mat file extension is associated with Ox. Ox is an object-oriented statistical system. At its core is a powerful matrix language, which is complemented by a comprehensive statistical library (for more information on the .mat file type and associated software, please visit https://www.file-extensions.org/mat-file-extension-ox-object-oriented-matrix-programming-language-matrix).

National Transportation Library (NTL) Curation Note:
As this dataset is preserved in a repository outside U.S. DOT control, as allowed by the U.S. DOT's Public Access Plan (https://ntl.bts.gov/public-access) Section 7.4.2 Data, the NTL staff has performed ***NO*** additional curation actions on this dataset. NTL staff last accessed this dataset at https://digitalcommons.lsu.edu/transet_data/85/ on 2021-07-19. If, in the future, you have

trouble accessing this dataset at the host repository, please email NTLDataCurator@dot.gov describing your problem. NTL staff will do its best to assist you at that time.