

ACTS Calc

About the software and authors:

The Asphalt Concrete Thermal Stress Calculation (ACTS Calc) is a software developed at The National Center of Excellence for SMART Innovations at Arizona State University (ASU). It involves and enhances previous research studies on the calculation of the thermal pavement profile using a 1-D semi-infinite thermal model and the estimation of the pavement's thermal stresses using mechanical analogs. This tool was first realized on a Jupyter Notebook with a Python kernel, and then translated into a Graphical User Interface (GUI) developed with the DearPyGui library.

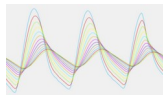
Although pavements are robust structures capable of supporting large traffic loading and the inclement weather, temperature differences during the time extensively affect paved roads. As a result of this phenomenon, thermal cracking appears in the pavement. The propagation of cracks due to thermal cracking produces significant damage to the integrity of the pavement and generates pathways for the intrusion of water into the granular layers and subgrade as well. Thermal cracking as a damage mechanism has been broadly studied, however, more research is needed about the mechanisms linked to different temperatures to understand the thermal cracking potential.

Understand, model and predict thermal cracking are still needed to improve the performance of roads. The goal of this software is to calculate thermal stresses within the asphalt pavement due to the environment's thermal fluctuations. The outcomes of this tool provide an indication of how resilient a pavement is in terms of thermal cracking to support the decision-making process in pavement management systems.

The authors of this software are:

Benjamin Mailhe, Ph.D., Mechanical Engineer, M.Sc. in Materials and Technological Innovations (Technological University of Compiègne, France) and Ph.D. in Electrical Engineering (Federal University of Santa Catarina, Brazil). He specialized in the experimental study of complex material behaviours and their implementation within numerical codes, such as Finite Element Method (FEM) and Finite Difference Frequency and Time Domain (FDFD/FDTD) techniques. He now mainly focuses his research in Computational Electromagnetism (CEM) and magnetic materials, themes he taught for two semesters at the Nacional University of Colombia, Bogotá. He currently works as a Postdoctoral Fellow at the Grenoble Electrical Engineering Laboratory – G2Elab (UMR5269 - CNRS - Grenoble INP - UGA) inside the Materials and Advanced Electromagnetic Devices Team – MADEA+, in partnership with Altair Engineering Inc.

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Kamil E. Kaloush, Ph.D., P.E. Awarded as FORTA Professor. Professor in the School of Sustainable Engineering and the Built Environment, affiliate faculty in the School of Sustainability and director of the National Center of Excellence on SMART Innovations. He is a registered Professional Engineer (P.E.), and has more than 30 years of experience in pavement research and management services. His areas of expertise include pavement materials design, thermal properties, advanced laboratory testing, field performance evaluation, and pavement management systems. His honors and awards include: Top 5% teachers in the Ira A. Fulton Schools of Engineering; AzBusiness Leaders – Research; Greater Phoenix Area E-Week Outstanding Engineering Educator; Rubber Pavements Association Outstanding Research Award; IRF Global Awards. Asphalt Rubber Ambassador; Board of Directors: Transportation Research Board Design and Construction Group Executive Board; International Road Federation (IRF); Rubberized Asphalt Foundation; Arizona Council for Transportation Innovation; Civil Engineering Examination Committee, National Council of Examiners for Engineering and Surveying; and vice chair of the Technical Advisory Board of the Rubber Pavements Association.

Hasan Ozer, Ph.D. Hasan Ozer is an associate professor in the School of Sustainable Engineering and the Built Environment at Arizona State University. His research focuses on pavement materials characterization, pavement design and analysis, and development of rehabilitation and preservation programs. Ozer develops computational mechanics methods for structural performance modeling of pavements and uses life-cycle assessment tools for advancing sustainable transportation infrastructure.