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Project Title

Carbon Footprint for Hot
Mix Asphalt and Portland
Cement Concrete Pav-
ements

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Project Summary

Technology Transfer Outreach Publication

Carbon Footprint for HMA and PCC Pavements

This study aims to establish a carbon footprint for Hot Mix Asphalt (HMA) and Portland Cement Concrete (PCC) Pavements for reconstruction, rehabilitation and Capital Preventive Maintenance (CPM) projects. The study will consider emissions of greenhouse gases due to energy consumption and material usage during the material acquisition and manufacturing and construction phases (primary impacts) as well as those due to vehicle use and maintenance during the serviceable life of the assets (secondary impacts). Carbon dioxide emissions for different design types were determined and categorized for application to various reconstruction, rehabilitation and preventive maintenance projects. The application, in the form of a website benchmarking and design tool, will provide decision-makers with alternative strategies that optimize GHG (Greenhouse Gas) emission impacts of highway construction and rehabilitation projects.

Global climate change is a critical challenge that necessitates agencies involved in the development and maintenance of transportation infrastructure to identify their contributions to green house gas emissions. In response, it is important to calculate metrics to measure carbon footprints and greenhouse gas emissions, and develop standards that can be used to construct, rehabilitate and maintain transportation infrastructure. In this study, we have developed a tool that measures the carbon footprint of Hot Mix Asphalt (HMA) and Portland Cement Concrete (PCC) pavements for both the reconstruct and rehabilitation projects including pertinent Capital Preventative Maintenance Program (CPM) treatments. The aim of this research is to calculate the carbon footprint for different HMA and PCC pavement sections and develop recommendations on how the established footprints can be used for the development of green construction standards.

Research Objectives

Provide a research tool that allows decision-makers to investigate alternative strategies that optimize GHG emission impacts of highway construction and rehabilitation projects .

Methodology

This research was conducted using the following methodology:

- Phase I: Data Collection - Data was collected from 14 pavement construction and maintenance project sites to develop comprehensive inventories of material and equipment use for each project.
- Phase II: Inventory Development - Detailed inventories were developed by organizing the data collected into material and equipment categories.
- Phase III: Assessment - An assessment tool was prepared that allows further investigation and benchmarking of highway construction projects based on inventories developed.



University Facts

Total Enrollment	6,550
Graduate Enrollment	916
Number of Faculty	417
Placement Rate	95%

Michigan Tech is located in Houghton, MI on the south shore of Lake Superior. This rural area is known for natural beauty, pleasant summers, abundant snowfall, and numerous all-season outdoor activities. In addition, the University maintains its own downhill and cross-country ski facilities and golf course. There are numerous cultural activities and opportunities on campus and in the community. Michigan Tech has also been rated as one of the safest college campuses in the United States, and the local community provides excellent resources conducive to an outstanding quality of life.

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Future Work

Future work will focus on calibrating the developed decision-making tool to reflect expected and actual long term economic and environmental pavement performance metrics.

Anticipated Research Findings

The anticipated research finding will include the following deliverables:

- A benchmarking and design tool used to analyze alternative pavement designs.
- Decision-making framework for choosing pavement technologies incorporating GHG emission impacts.
- Recommendations on green construction standards and specifications that can be used by stakeholder agencies and decision-makers.

Anticipated Implementation

A recommendation report will be submitted to stakeholders so they have a better understanding of the life cycle assessment of and more specifically the GHG emissions associated with alternative pavement designs. This will also help researchers and engineers identify and quantify GHG emissions, thus outlining the key GHG contributors and highlighting where reductions can be made.

Project Emission Estimator (PE-2)

http://www.construction.mtu.edu:8000/cass_reports/webpage/

The screenshot shows the PE-2 Project Emission Estimator website. The top navigation bar includes links for HOME, METHODOLOGY, INVENTORY, ESTIMATOR (which is highlighted in yellow), and CONTACT US. Below the navigation, there are two main sections: 'PE-2 TOOL' and 'THE ESTIMATOR TOOL'. The 'PE-2 TOOL' section lists three sub-tools: Material Estimator, Equipment Estimator, and LCA Estimator, each with a small icon. The 'THE ESTIMATOR TOOL' section describes the Project Emission Estimator (PE2) and lists three types of emission reports: Material Use Emissions Report, Equipment Emissions Report, and Pavement Life Cycle Report. Further down, there are sections for 'PE-2 INVENTORY' (listing Project Inventory, Emission Factors, and Life Cycle), 'PROJECT INVENTORIES' (describing the Emission Inventory Tool), and 'Generate Reports for each Contract' (with a dropdown menu set to 'I-69 Concrete Reconstruct'). At the bottom, there is a 'Query' input field and a footer with links to HOME, METHODOLOGY, INVENTORY, ESTIMATOR, and CONTACT US.

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