NS 533: Hot Shots for Cold Climes - Evaluating Treatment of The Hardest Icy Spots: Literature Search

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Resources searched: ASCE Library, MnDOT Library Catalog, Transport Database, Research in Progress, Web

Summary: Results are compiled from the databases named above. Links are provided for full-text, if applicable, or to the full record citation. I completed my searches using the following terminology: ice control, deicing, snow removal, anti-icing, trouble spot, problem area, problem spot, problem location. The results are divided into most relevant and less relevant

Most Relevant Results

Result 1.

Title
Qualified thermal mapping in Castilla-Leon, Spain.

Source
Conference Title: 24th World Road CongressWorld Road Association (PIARC). Location: Mexico City. Sponsored by: World Road Association (PIARC). Held: 20110926-20110930. 2011. 12p (Figs., Photos., Refs.)

Abstract
One of the most critical issues in road management is the treatments provided to prevent ice formation on the road surface. One of the many techniques employed to optimize the application of these treatments is the creation of thermal road maps. Thermal mapping provides a "thermal fingerprint" of a road, identifying stretches of road that, under different conditions, remain abnormally cold or abnormally warm. This information can highlight potential trouble spots and, with the right equipment and weather predictions, even be used to produce predictions regarding the future state of road conditions. Models such as that are successful in finding ways to alert road managers as to the spots along the road where ice or snow accumulation may occur. They are not so, however, in interpreting how risky this will be to the user, based on the characteristics of the road. Ice formation, for instance, is always a risk, but less so in a straight road along a plain than in a curve overlooking a cliff. In the N601 road in Valladolid, Spain, a pilot project was created to include other categories of factors related to driving risks in an application that is based on known thermal mapping techniques. These "road safety factors" are taken into account in providing the road managers with suggestions of areas they should prioritize in the anti icing treatments. These factors include variables such as road friction measurements in dry conditions, crossfall, alignment, collision obstacles near the road, areas lacking safety barrier, high embankments, traffic density etc. Each is weighed independently and a coefficient is
produced that, applied to the icing potential prediction based on thermal mapping, provides managers with an automated system alerting them to trouble spots.

Publication Year 2011

Result 4.

Title IOWA'S COOPERATIVE SNOW FENCE PROGRAM.
Source 1998/9. 5 p. (1 Tabs.)
URL http://www.smartbridge.okstate.edu/new_information/winter_maintenance/snowfence.pdf
Abstract While we can't keep it from blowing, there are ways to influence the wind that carries tons of blowing and drifting snow. Periodically, severe winter storms will create large snow drifts that close roads and driveways, isolate farmsteads and increase snowplowing. Many of these drifting problems happen in the same place year after year. Although there are no foolproof methods of wind and snow control, properly designed and maintained snow fences can reduce or eliminate these problem areas. This publication discusses the benefits of snow fences, then examines the types used by the Iowa Department of Transportation. Finally, it provides information about how individuals can get involved in the DOT's Cooperative Snow Fence Program.

Publication Year 1998

Result 6.

Title PASCON: AN EXPERT SYSTEM FOR PASSIVE SNOW CONTROL ON HIGHWAYS.
Source Transportation Research Record. 1991. (1304) p. 193-201 (5 Figs., 13 Refs.)
Abstract Blowing and drifting snow is a common occurrence on roadways in cold regions that cause reduced visibility and snowdrifts on the roadway, resulting in hazardous road conditions and partial or total road closure. Consequences include longer travel time, greater maintenance and snow control costs, and more vehicle accidents involving property damage, personal injury, and, in extreme cases, loss of life. Passive snow control is the name given to methods offering some control over where wind-driven snow will or will not be deposited. Passive snow control techniques include snow fences, shelterbelts, and design of aerodynamic roadway sections. Currently, no widely accepted algorithmic methods exist for passive snow control on highways. The main objective of the project was to provide a tool for highway design and maintenance personnel to use in evaluating snow problem locations and identifying possible solutions, without requiring an extensive knowledge of passive snow control methods. To this end, an expert system, PAssive Snow CONtroller (PASCON), was developed on an IBM PC microcomputer. PASCON incorporates knowledge from a nationally recognized expert in passive snow control and from the literature. PASCON includes five external programs for design procedures, computations, and graphics. Several
consultations with the expert system yielded results that agreed with the domain
expert and with solutions worked out manually.

Publication Year 1991

Result 8.

Title The appliance of science.

Source SURVEYOR. 2007/08/30. pp16-17

Abstract This article discusses the use of brine spraying on road surfaces in place of rock salt or
grit. Brine is effective at removing ice and preventing its formation, as it is already
active when it reaches the surface. It can be delivered direct to the problem area with
less wastage and run-off. As weather patterns alter, the need for alternative
treatments increases, and brine treatment provides the potential for urgent response
to changing conditions. As salt usage is lower, the introduction of brine reduces
costs and transportation requirements. Multi-action vehicles can be employed, with
use of different treatments controlled by the driver. The percentage of salt in a
treatment mix can also be altered as needed. The author concludes that versatility is
key to efficient road treatment, with pre-wet salt remaining the optimum.

Publication Year 2007

Least Relevant Results

Title Identifying best practices for snowplow route optimization / prepared by Jonathan

Summary Well-designed winter maintenance routes result in snow and ice control service that
is both more effective, because roads are cleared more rapidly, and more cost-
efficient, because deadheading, route overlap and other inefficiencies are reduced or
eliminated. There are an increasing number of computerized tools to facilitate the
routing process, but these tools are not yet widely used by winter maintenance
practitioners. The purpose of this report is to provide practitioners with an overview of
computerized route optimization processes and concrete recommendations about how
to ensure that route improvement efforts produce actionable results.
Recommendations are synthesized from nine recent and ongoing snowplow routing
projects using a variety of computerized routing tools. Project descriptions, based on
interviews with project personnel, focus on project goals, optimization software
features used, and lessons learned. Multiple route optimization projects report route
length reductions on the order of 5% to 10%, with reductions as high as 50% reported
in one case. These snowplow route optimization projects show that route optimization
is a powerful tool for improving routing efficiency but that it does not replace the need
for expert judgment in the route design process. Successful route optimization projects
rely on close cooperation between experienced winter maintenance professionals and
the individuals conducting the route optimization as well as a highly accurate,
snowplow-Urouting specific representation of the road network. Successful projects also include time to review and revise new routes to identify potential problem spots prior to implementation.

Addnl Physical Form

Electronic Version


Project page -- [http://clearroads.org/project/14-07/](http://clearroads.org/project/14-07/)

Sustainable Heated Pavements for Infrastructure Longevity, Safety and Economic Competitiveness

Icing of pavements during the winter leads to problems affecting the majority of the U.S. Department of Transportation's (USDOT's) strategic goals. Icy roadways clearly pose a hazard to the safety of drivers and vehicle occupants. Icy roads also affect economic competitiveness as truck based transport of goods is slowed or interrupted. The use of de-icing agents, such as salt and Magnesium Chloride, can help prevent ice build-up on the roads, but bring with them significant initial and long term maintenance costs. Beyond the costs associated with purchasing and applying the materials, the application of chloride based agents to steel infrastructure (e.g. reinforced concrete pavements and bridge decks and steel bridge components) can lead to corrosion and possible premature failures. The American Society of Civil Engineers current grade of the U.S. roads is a D and bridges are a C+ (ASCE 2013). The deterioration caused by corrosion raises technological and economic issues associated with the state of good repair goal including how to inspect, manage, and repair deteriorating transportation structures. The use of these chemicals to prevent icing also has environmental costs, relating to the goal of sustainability. The climate of the Region 8 states served by Mid Planning Conference (MPC) means that icy roads are a national issue of great local significance. Heated pavements offer a potential solution for the problems caused by icy roads. New research is investigating the application of heated pavements to keep airport runways clear and decision making tools to help airport managers decide when the heated pavements or other snow clearing solutions are viable (Vigar 2013). Heating a full network of roads is likely not viable at this point, but the targeted heating of particular safety trouble spots, critical freight routes, and heavily salted areas has the potential to make significant contributions to the quality of U.S. and regional transportation networks. These networks often include generous right-of-way areas that may lend themselves to supporting a distributed energy producing infrastructure; potentially decreasing costs in remote locations. The presence of ice in concrete pores is a fairly well-understood process (Penttala 1998, Kauffmann 2004) that can accelerate environmental degradation of pavements or other roadbases. A number of novel approaches have been attempted, including conductive concrete (Yehia and Tuan 1999, 2000, 2004, Tuan 2004), conductive asphalt (Chen and co-workers 2011), heated wiring (Tuan 2004, Zhao and co-workers 2010) and there has been at least one full bridge demonstration project reported in the literature (Tuan 2008). However, there are no broad-based design or implementation guidelines for use of this class of technology, nor is there a fixed approach for powering such methods. Three key questions arise regarding the feasibility of a targeted heating approach: 1) How will locations where pavements will be targeted for heating be determined to make significant contributions to improving safety, movement of goods, longevity of infrastructure and/or impact on the environment? 2) How will the appropriate source of energy necessary to heat the pavements be evaluated for each site in a sustainable manner (i.e. considering the triple bottom line)? 3) What type of paving technology can be effectively heated with the available energy or in a way that minimizes the energy demand?
