Numerical Modeling of Heated Pavement Systems

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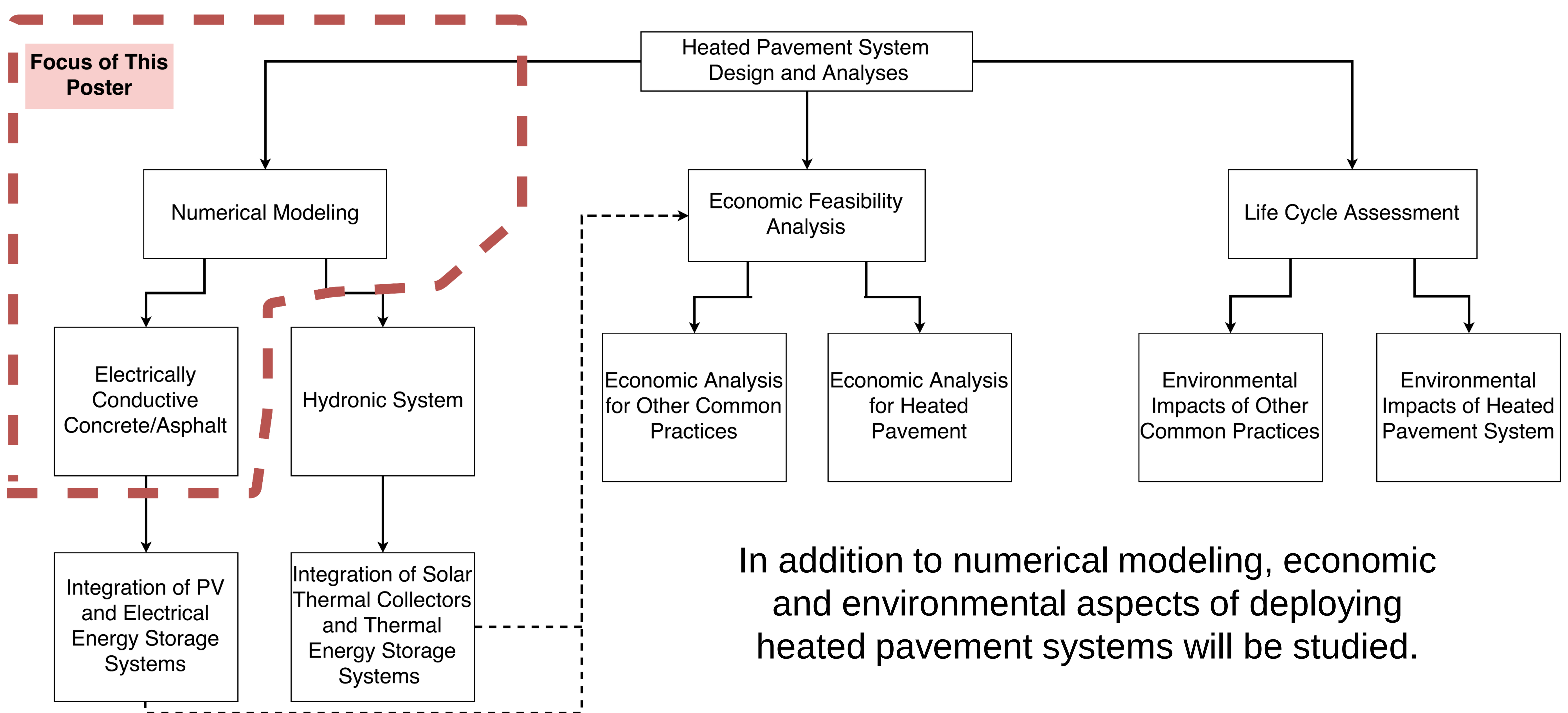
Introduction

Confronting snowfall and pavement icing at airports in order to prevent long delays in scheduled flights has always been a challenge for airliners and the airport authorities. To address these concerns, electrically conductive asphalt and Portland cement concrete (ECON) is currently a focus area of pavement design, which applies a potential difference to a surface conductive concrete layer, heating up the pavement to melt the snow and ice.

Project Overview



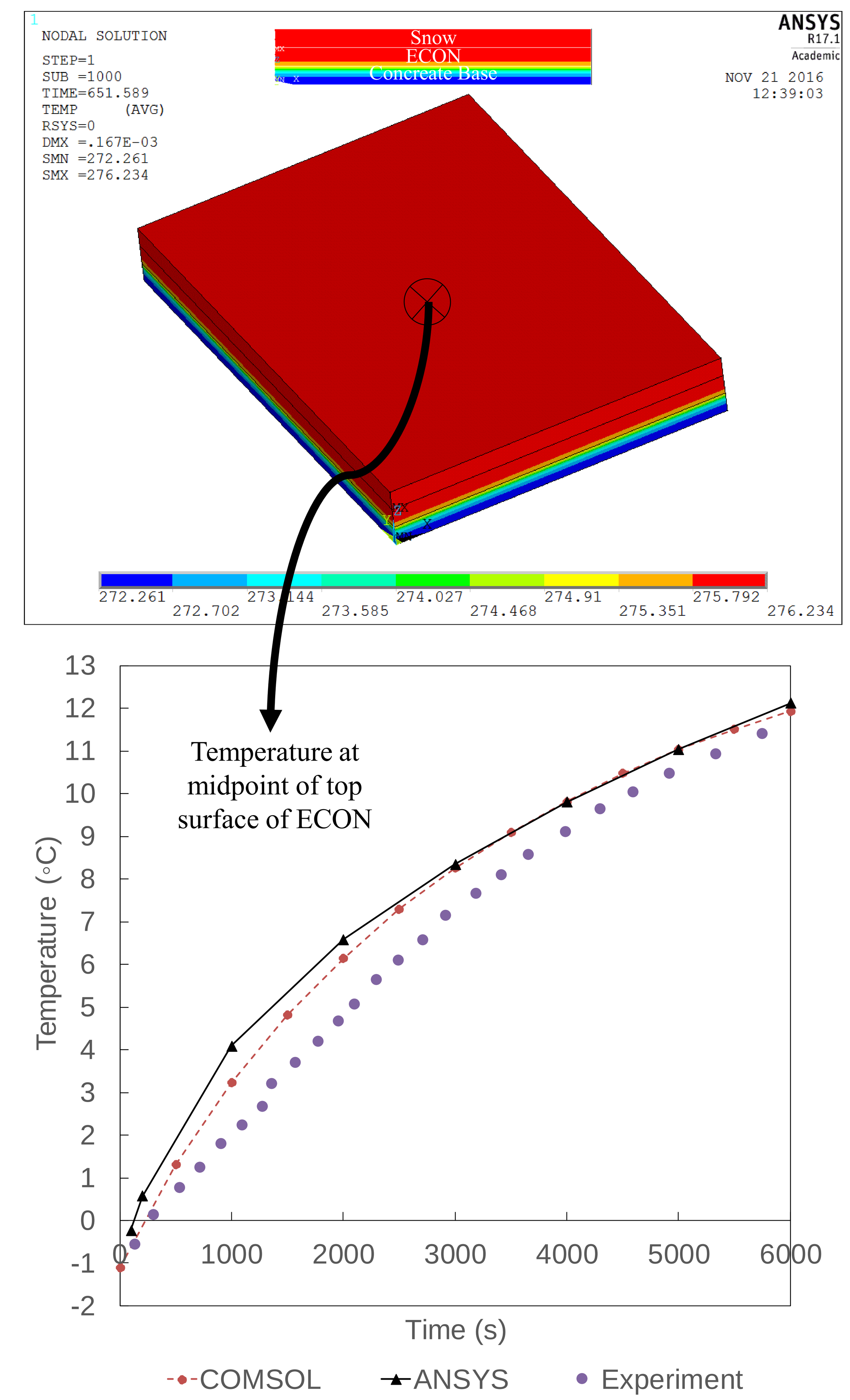
In addition to numerical modeling, economic and environmental aspects of deploying heated pavement systems will be studied.

This study develops a finite element (FE) model of ECON in ANSYS, validated through experimental data, for evaluating its thermal performance considering different climatic conditions. The sensitivity of the heat generation to material parameters of the ECON is investigated to determine the required accuracy for measuring each parameter and possible errors in the results. Initial results of the temperature increase on the top surface of FE model are consistent with the available experimental data which indicates that a FE model would be promising for performing feasibility studies and use in preliminary design and control strategy development of the conductive pavement systems.

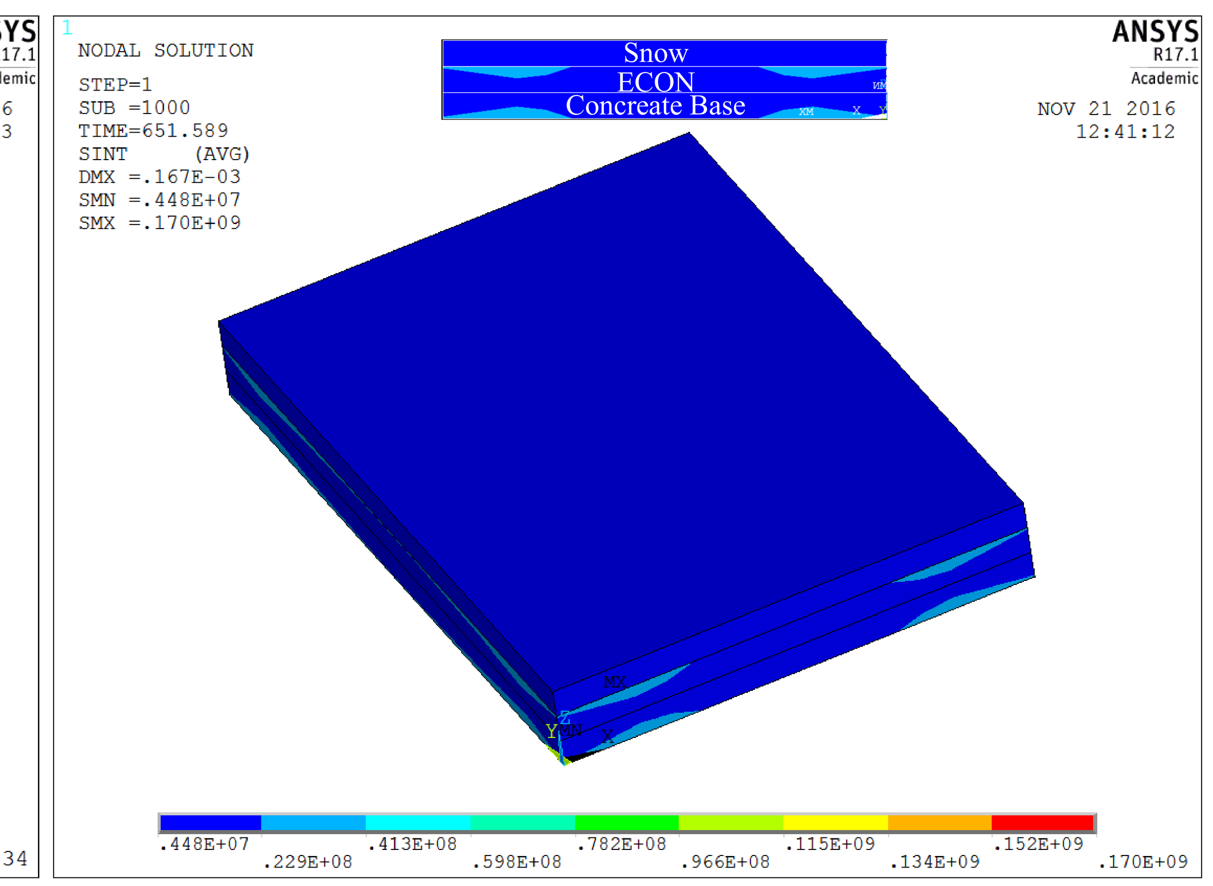
Numerical Model of Electrically Conductive Concrete

Electrical Resistivity | **Density** | **Thermal Conductivity** | **Specific Heat Capacity** | **Thermal Expansion Coefficient**

Temperature Distribution



Stress Intensity Distribution



Studied Case:

- 80 V potential difference applied at sides of the model
- Temperature of a 5 cm snow layer increased above 0˚C after 600 s.
- Temperature at midpoint of the top surface of ECON was fairly consistent with the measured temperature
- Stress analysis conducted by fixing the translational DOFs at the sides of the slab
- Stress distribution due to thermal expansion for the given case does not seem to be considerable

Future Steps of Numerical Modeling

- Modeling the melting process of ice/snow
- Calculation of energy consumption for ice/snow removal process
- Validation of model with more experimental data from DSM airport
- Study the technical performance of the system for different scenarios

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