

RESEARCH TEAM

Iowa State University

- Principal Investigator – **Bora Cetin**

Assistant Professor – Department of Civil, Construction & Environmental Engineering

- Research Personnel – **Patrick Bollinger**

PhD Student – Department of Civil, Construction & Environmental Engineering

GeoEngineering Consulting, LLC

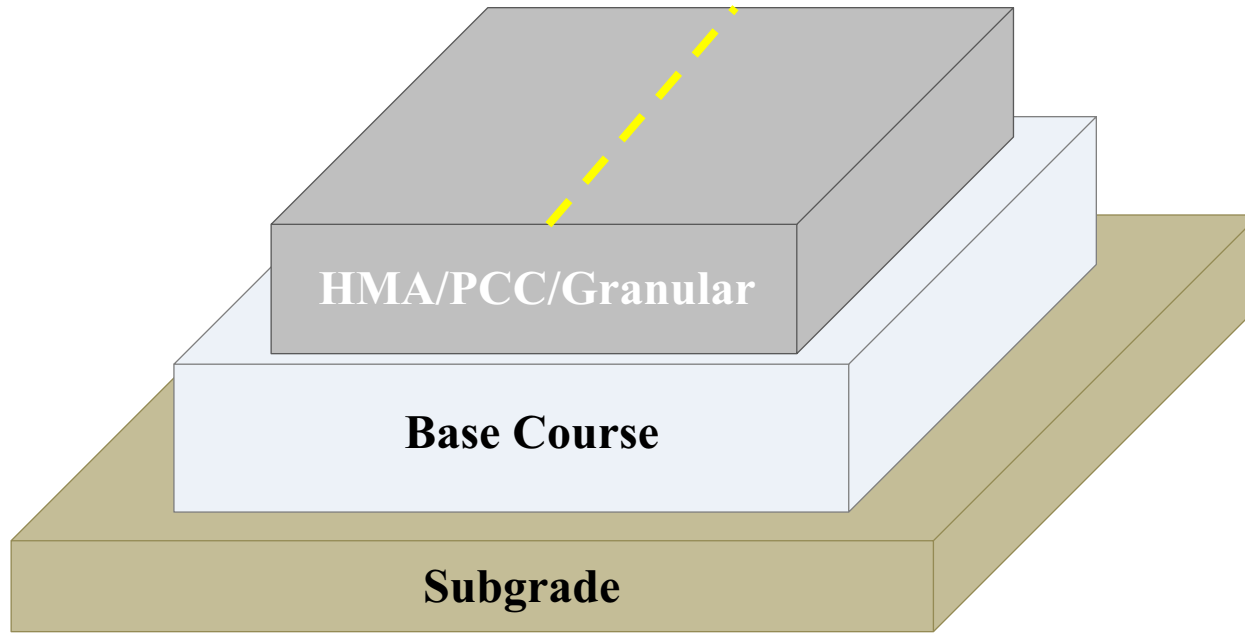
- Co-Principal Investigator – **Tuncer B. Edil**

President and Chief Engineer

OUTLINE

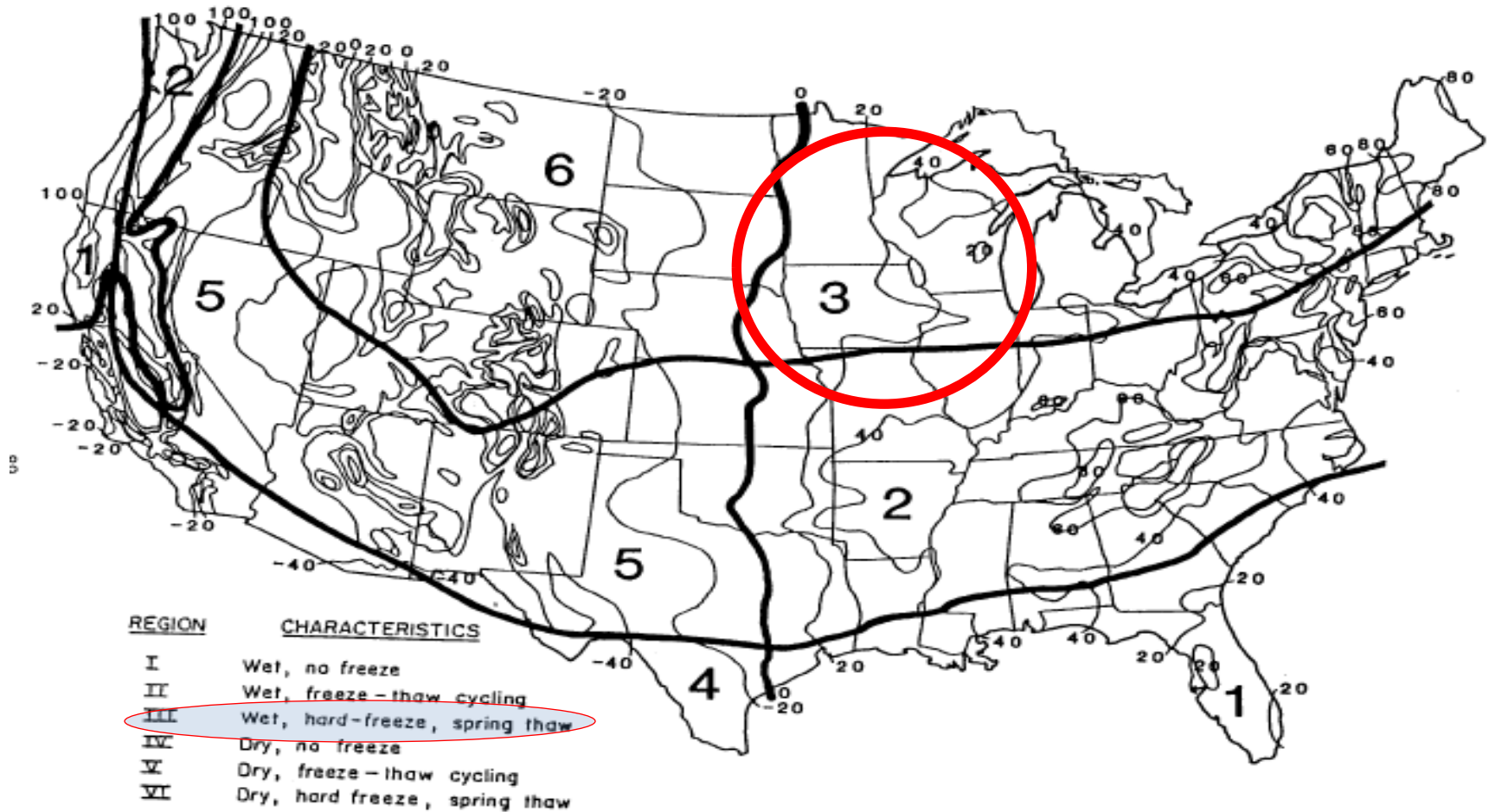
- Introduction
- Research motivation
- Objectives
- Research plan
- Future expectations

INTRODUCTION



INTRODUCTION

- Six climatic regions in the United States for pavement design



INTRODUCTION



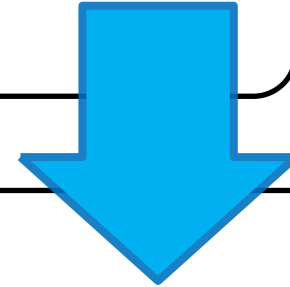
INTRODUCTION

- **Characterization of Geomaterials**
 - Stiffness/Resilient modulus
 - Permanent deformation
 - Shear strength
 - **Freeze-thaw durability**
 - Moisture susceptibility
 - Drainage

OBJECTIVES

1st Goal – Develop a model to predict:

- Maximum/minimum frozen soil depth
- Duration of freezing/thawing
- Moisture changes



2nd Goal – Develop a model to predict the pavement performance after severe freeze-thaw cycles

- FWD
- Index properties
- Thermo-hydro-mechanic model

RESEARCH PLAN

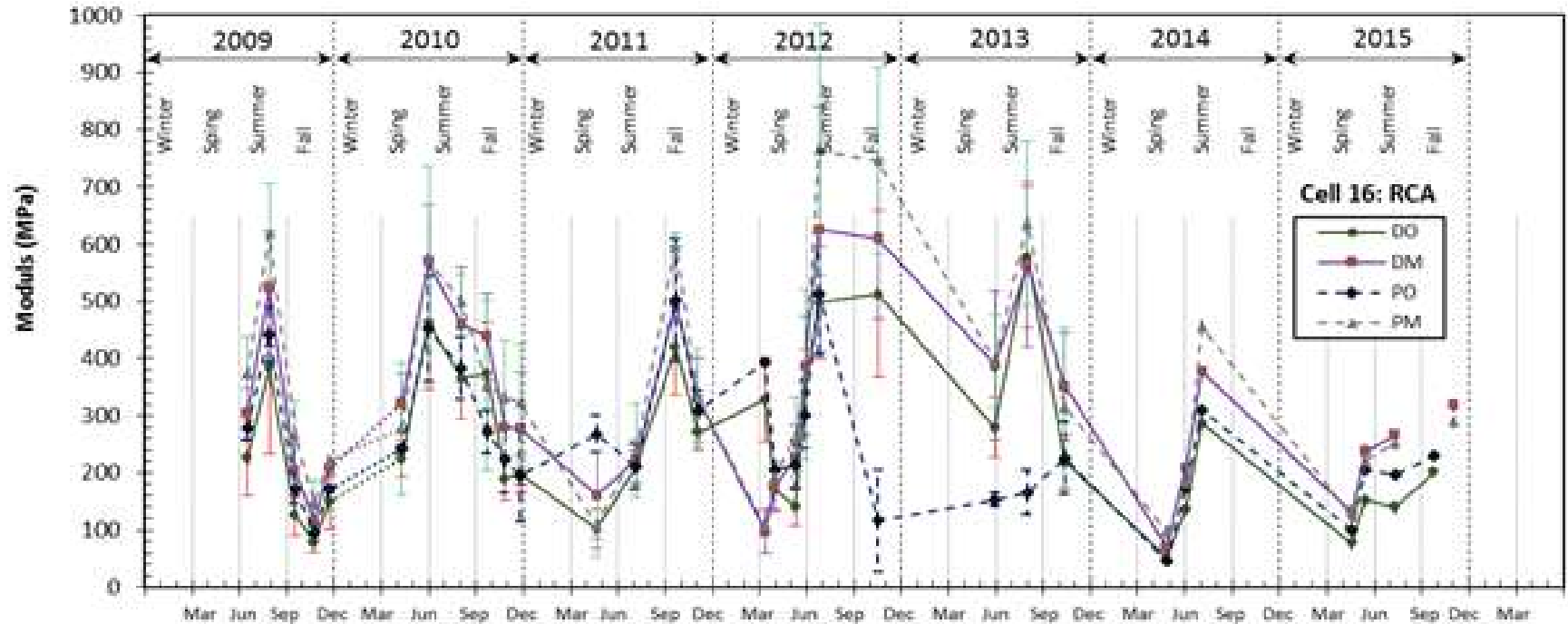
- **Task 1** – Initial memorandum on expected research benefits and potential implementation steps
- **Task 2** – Field data collection
- **Task 3** – Modelling analyses
- **Task 4**– Draft/final report

Task 2-Field Data Collection

The following data will be collected

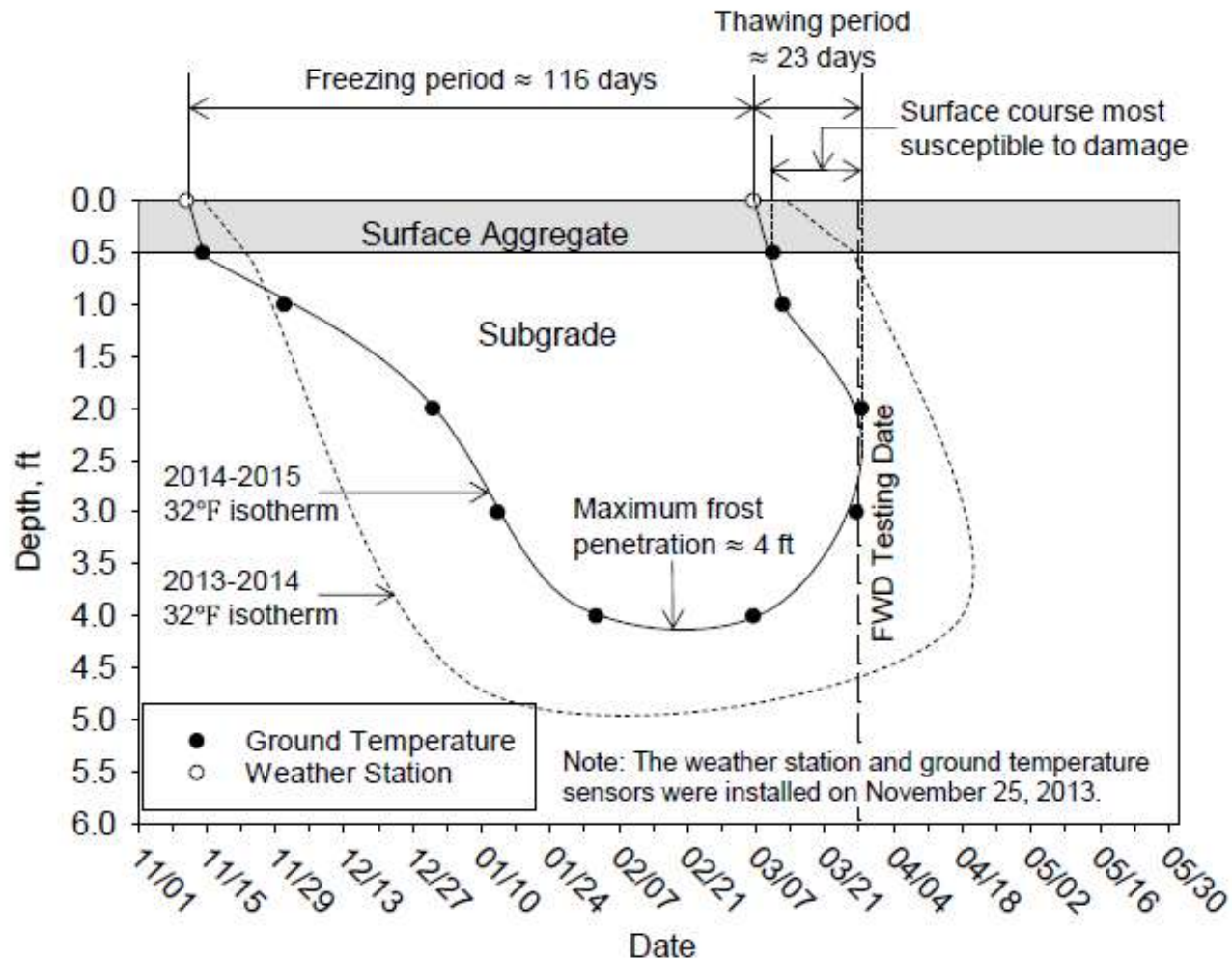
- FWD
- Frost heave-thaw settlement
- Temperature
- Moisture
- Matric suction
- Climate data
 - Air temperature, wind speed, solar radiation, relative humidity, and precipitation

Task 2-Field Data Collection



FWD elastic modulus of RCA base layer during 7 years (Data collected from MnDOT 2008 project).

Task 2-Field Data Collection

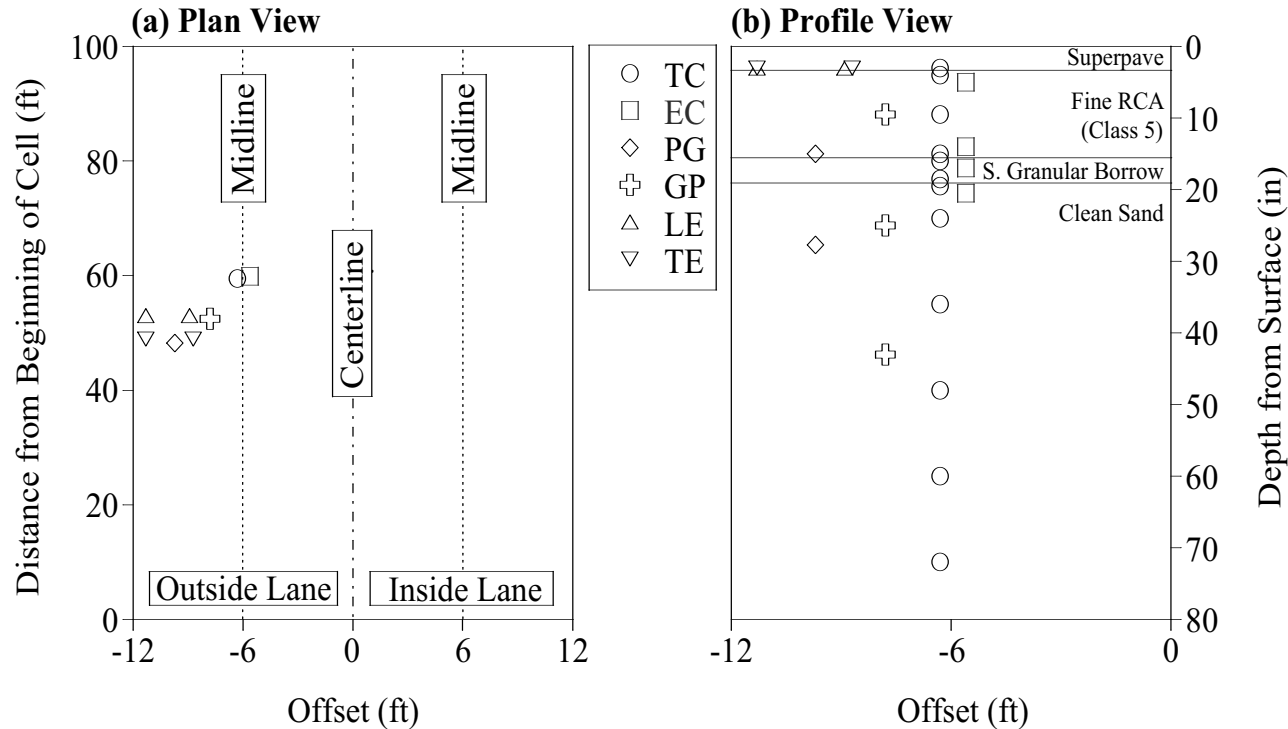


Task 3-Modelling Analyses

- **Multi-physics Modelling**
 - Pavement parameters
 - Soil parameters
 - Climate data
- **Software**
 - SHAW
 - COMSOL
 - PLAXIS
 - TEMP/W

Expected Research Results

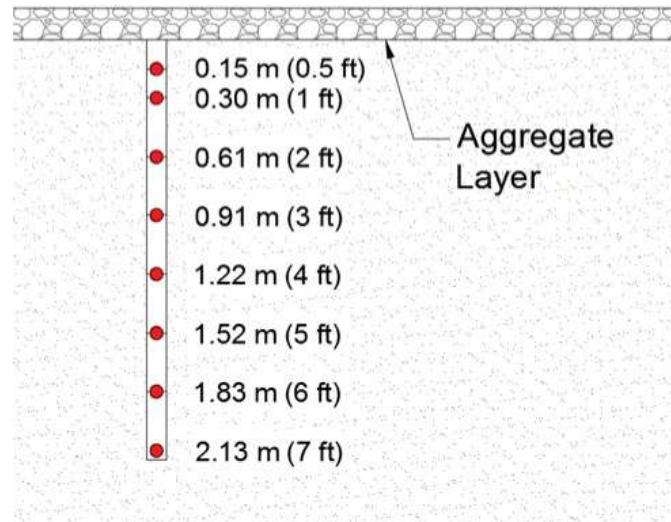
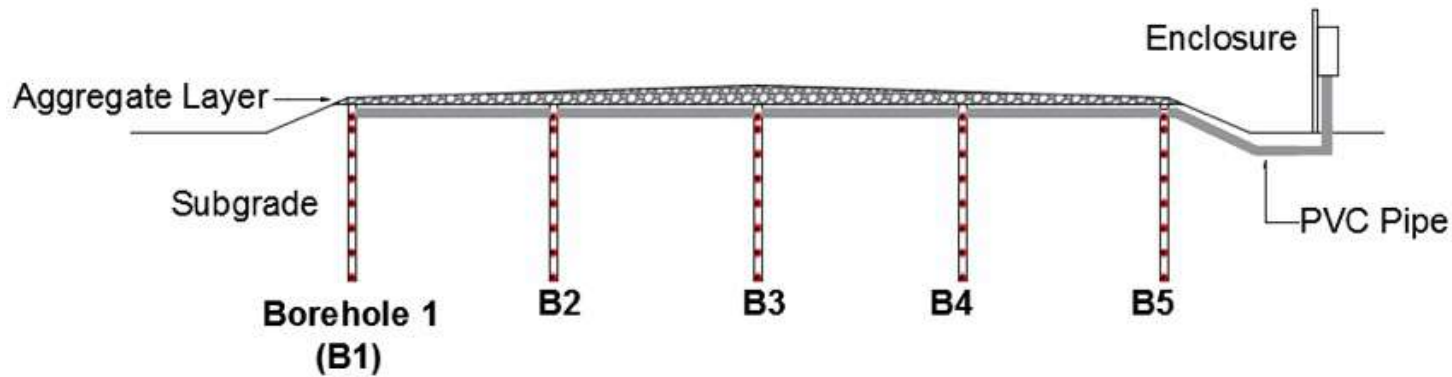
Current Sensor Installation at MnDOT



TC = Thermocouple, EC = Moisture probe, PG = Dynamic pressure cell, GP = Geophone, LE = Longitudinal dynamic strain gauge, TE = Transverse dynamic strain gauge

Expected Research Results

Proposed Sensor Installation at MnDOT



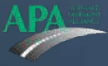
Task 4-Draft/Final Report



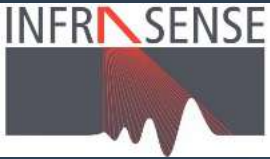
SCHEDULE

Task No.	Months								
	1	2	3	4	5	6	7	8	9
1	■								
2	■	■	■						
3			■	■	■	■	■		
4							■	■	■

NRRRA
National Road Research Alliance



Thank You



Develop → Collaborate → Research → Implement → Sustain.