

# Durability Synthesis

National Concrete Pavement  
Technology Center



# Background

- The need
  - Superpaveconc
- The actions to date
  - Formed a committee
  - Working on a synthesis
  - Developing a plan
- The future
  - Fill the gaps
  - Write specs



# Outline

- How does concrete fail?
- What can we measure now?
- Discussion
- What do we want to measure?
- What do we need?
- What's the Plan?



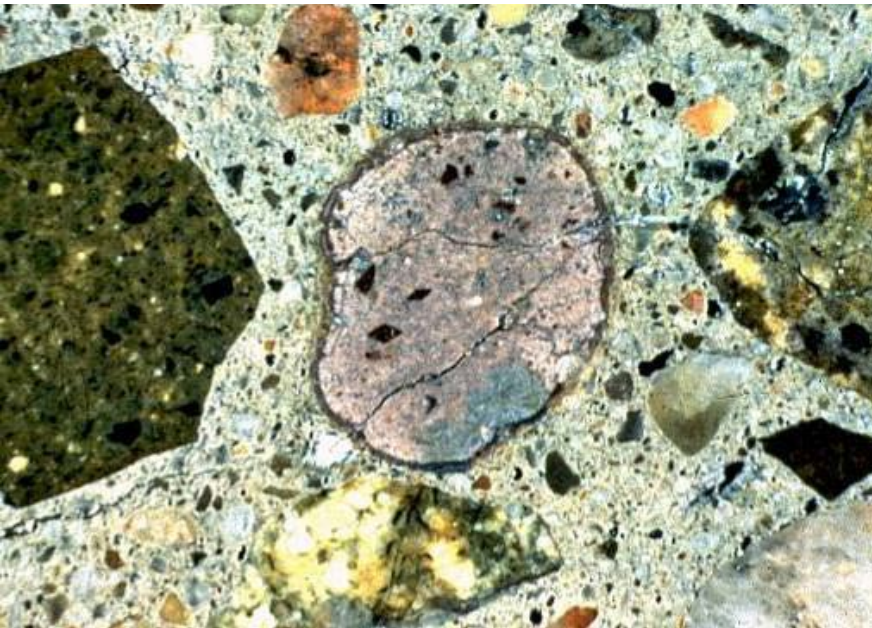
# Durability

Ability of the concrete to survive the environment to which it is exposed



# How Does Concrete Fail

- Internal Expansion
  - AAR
  - D-Cracking
  - DEF
  - Steel Corrosion



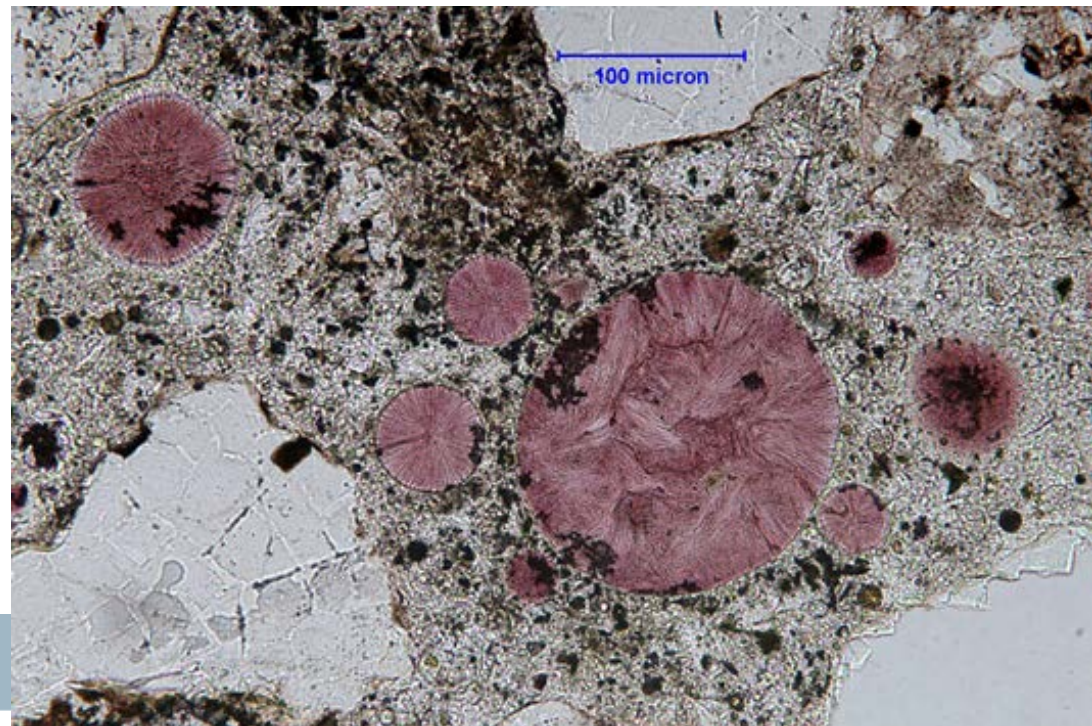
# How Does Concrete Fail

- Cold Weather
  - Freeze Thaw Cycling
  - Salt Crystallization



# How Does Concrete Fail

- Chemical Attack
  - Soft Water / Acid
  - Sulfates
  - Salts



# How Does Concrete Fail

- Overload / Fatigue
  - Support
  - Thickness
  - Drainage





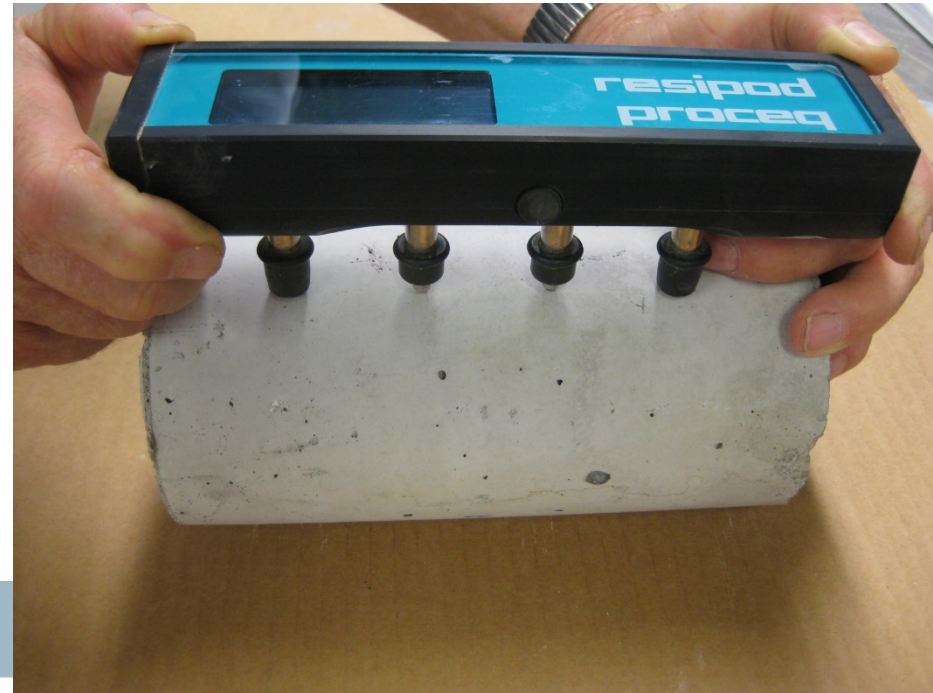
# Outline

- How does concrete fail?
- **What can we measure now?**
- Discussion
- What do we want to measure?
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# What can we measure now?

- Permeability
  - Resistivity
  - Rapid Chloride
  - Sorptivity
  - Gas Permeability



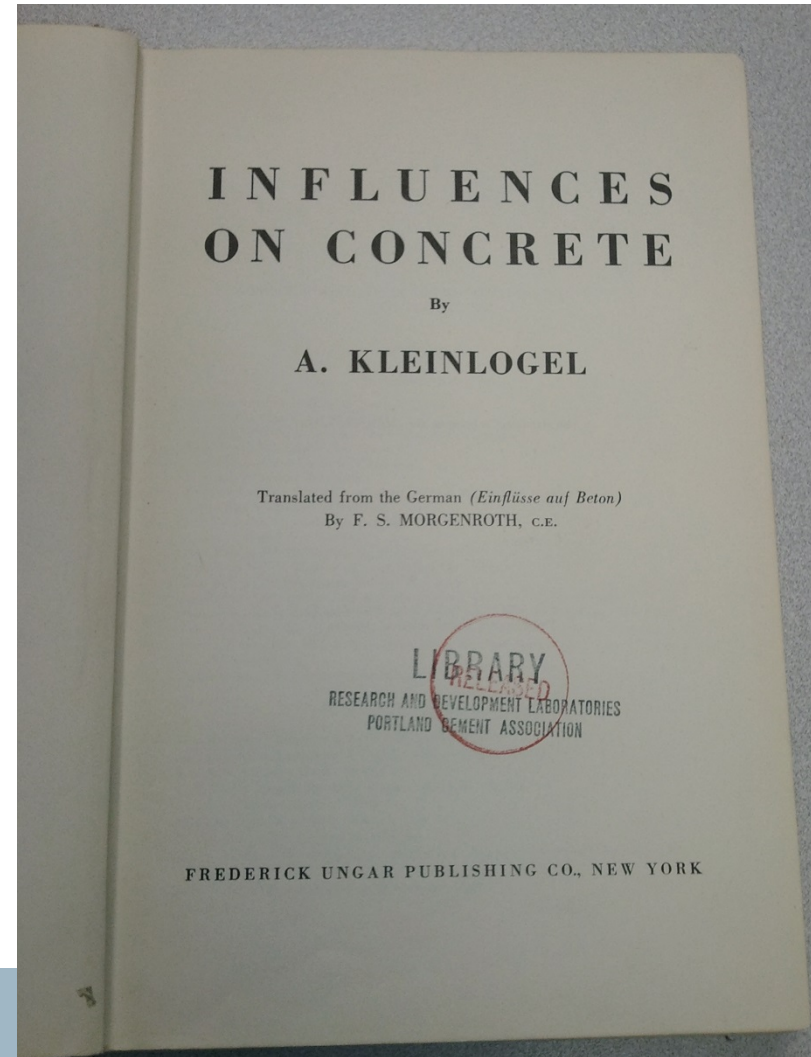
# What can we measure now?

- ASR
  - AASHTO Protocol
- D-Cracking
  - Iowa pore index method
  - Pressure release method
  - MIP
- DEF
  - Keep cool



# What can we measure now?

- Cold weather
  - C666
  - C672 / BNQ
- Soft water
  - None
- Sulfates
  - None for concrete
- Chemical Attack
  - Kleinlogel 1941



# Outline

- How does concrete fail?
- What can we measure now?
- **Discussion**
- What do we want to measure?
- What do we need?
- What's the Plan?

RMC Research Foundation

**Preparation of a Performance-based Specification for Cast-in-Place Concrete**

Prepared by:

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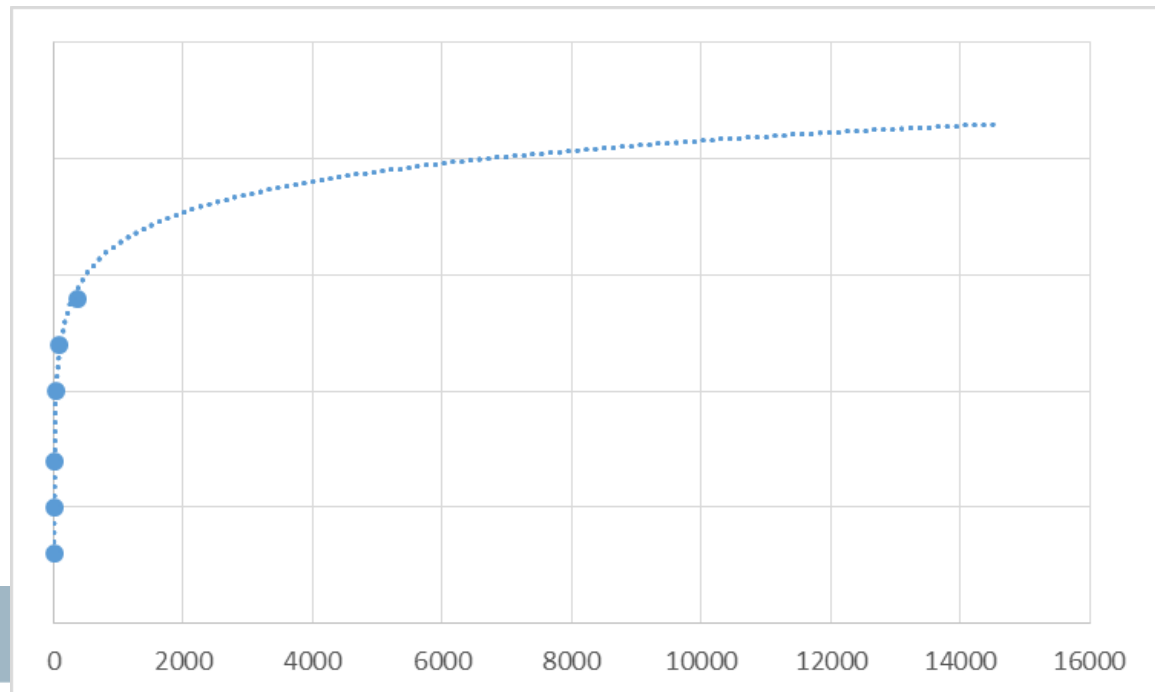
In Cooperation With:

Because even the best can become better.



# Discussion

- Reactions are slow
  - Attack takes time
  - Accelerating the test changes it
  - Extrapolation or interpolation



# Discussion

- Concrete changes over time
  - Hydration may continue
  - Cracking
  - Moisture state / temperature



# Discussion

- The environment is not constant
  - Yearly / daily changes
  - Local effects





# Discussion

- Workmanship issues
  - Only system fabricated on site
  - Incoming variability
  - Mixing
  - Transporting
  - Finishing
  - Curing
  - Transfer of ownership / responsibility



# Discussion

- Testing
  - Sampled where?
  - Takes too long
  - Costs too much
  - Tells us what?
- Can we afford in-line testing?



# Outline

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# What do we want to measure?

- Properties at design / proportioning stage
- Uniformity at delivery
  - Testing
  - 3'rd party records



# What do we want to measure?

- Reactivity
  - Pore chemistry
  - Microstructure
- Permeability
  - Fluids
  - Ions

Purdue University  
Purdue e-Pubs

Joint Transportation Research Program Technical  
Report Series

Joint Transportation Research Program

2010

## Portland Cement Concrete Pavement Permeability Performance

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# What do we want to measure?

- Proportions
  - What is in there?
  - How much?
- Workability
  - Slump
  - Rheology
  - Energy
  - The Box



# What do we want to measure?

- Air void system
  - After placement
  - Spacing factor
- Saturation
  - Locally (i.e.  $\frac{1}{4}$ "
- Cracking



# Outline

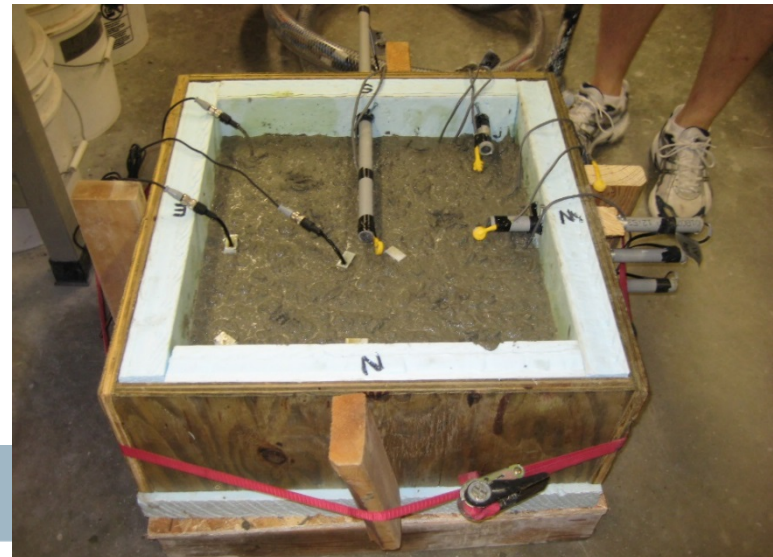
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# What do we need?

- Test methods
  - As above
- Calibration with something
  - Records of what we put down
  - Details of exposure
  - Start now, stay long
- A test bed
  - Lots of instruments
  - Deicing salts



# What do we need?

- Education

“I sometimes wonder if my career has not been an abject failure, because I have not been able to persuade a single structural engineer to think about durability”

- Name withheld to protect the innocent



# Outline

- How does concrete fail?
- What can we measure now?
- Discussion
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- What do we need?
- **What's the Plan?**



# What's the plan?

- Use what we have
  - Resistivity
  - Sorption
  - Gas permeability
- Keep those data
  - Don't be locked into a 4 year project cycle
- Test beds
- Develop tests (permeability, air, reactivity)
- Re-think the specifications
- Educate



# What Next?

- Priorities?
  - Implement
    - New(er) specifications and QC requirements
    - Current technology
  - Track performance
    - Keep records (databases, RFIDs)
    - Test beds
  - Develop / validate tests
  - Educate

