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Termites:
a
Research Challenge

Robert Setter, M.P.M.
Entomologist, Facilities Services Group

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Installation of a Permanent Physical Barrier to Subterranean Termites Using Crushed Limestone Aggregate?

The Problem

- Termite damage
- Infested Buildings
  - Wood
  - Masonry
- High value contents
- Year-round activity

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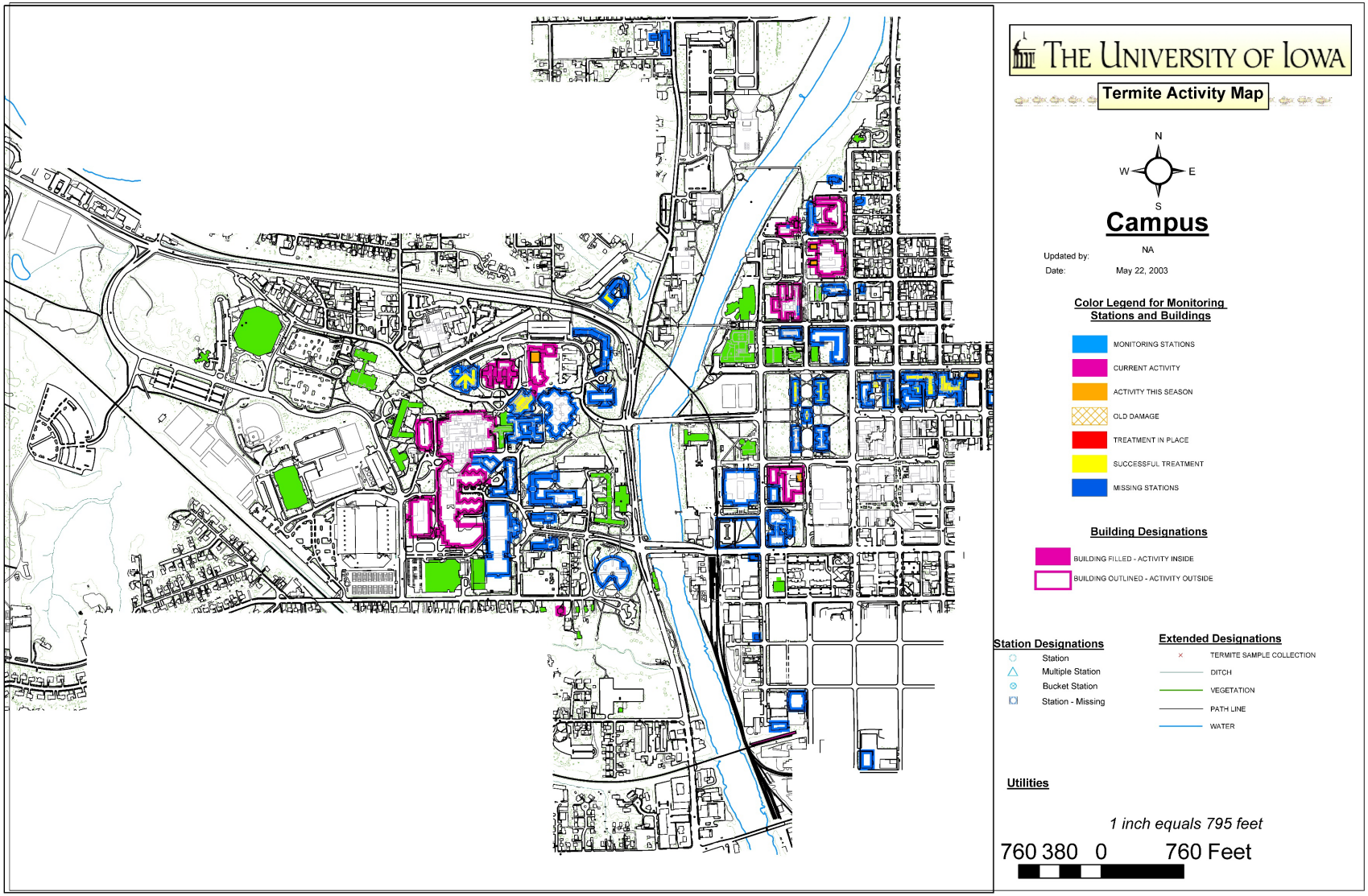

Building Summary

- 57 - currently monitored
- 29 - termite damage inside
- 8 - termite activity inside
- 23 - termite activity outside
- 23 - buildings to be added
- All on main campus

Termite Control

- Chemical pre-treat new construction
- Moving to physical barriers for pre-treat
- Sentricon® Colony Elimination System
  - Enhancement trials Dow AgroSciences LLB
- Monitor inside and out regularly
- Physical controls inside buildings
- Redesign Storage
- No trench and drench since 1994

Why Not Chemical Barriers?

- Politically sensitive
- Residence halls, hospitals, historical buildings
- Associated costs
- Iowa River
- Relatively short-term solution
- Long-term problem

Why Crushed Limestone?

- Success of others using aggregates
  - BTB in Hawaii (Tamashiro et al.)
  - Granitgard in Australia (Ewert et al.)
- Excellent performance in test tube trials
- Abundant in Iowa
- Local producer/collaborator
  - River Products Company Inc.
- Also a construction material*
- Long life-span (30 years + ?)

Site Conditions Favorable

- Pulse of construction continues
  - opportunity
- Creation of Entomologist position within O&M (1995)
- Termite monitoring network in place
- Control of site over time
- Close interaction with design, construction and maintenance staff

Implement Comparative Trials

- Will physical barriers be as or more effective than chemical barriers at preventing termite damage long term?
- Poor installation = failure
- Poor quality control = failure

Hypothesis

- Aggregate barrier will perform
  "as good as or better than"
  a pre-treatment chemical barrier,
  for preventing termite access to institutional buildings.

Aggregate Barrier Trials

Termite Prevention
FSG Entomology Lab

Implementation
FSG
College of Engineering
Consultants/Contractors

Aggregate Barrier Trials: Termite Prevention

Test Tubes
quick assay
small scale

Test Plots
long-term
moderate scale

Buildings
long-term
full size

Test Tube Trials

- Various aggregate grades
- 20 tubes per grade
- 200 workers, 2 soldiers
- 4” layer
- Cork food source
- Monitor daily to 30 days

Preliminary Results

- 66% of particles in size range
  - 50% of tubes fail
  - Substantial tunneling in all tubes
  - Separation of particle sizes
- 88% of particles in size range
  - No tunneling at all
- 98% of particles in size range
  - No tunneling at all

Preliminary Results

- 5 grades of aggregate tested within acceptable standards
- Attempting to optimize construction properties
- All have performed well in test tubes

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Test Plot Trials

- Termite infested barn (River Products Inc.)
- 75 sample units
- 5 treatments
- 20 replicates
- 5 foot spacing

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Test Plot Trials

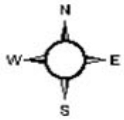
- 12” dia. concrete form
- 18” deep in soil
- 6” aggregate in base
- 13” wood post
- Aggregate around sides
- Metal flashing
- Monitor monthly, 5 years

Building Trials

- Main campus
- 15 buildings
  - 5 crushed limestone aggregate
  - 5 chemical pre-treatment
  - 5 nothing
- Constructed between 1997 - 2004

The University of Iowa

Termite Research Map



Crushed Limestone Aggregate Barrier for Termites:

proposed sites for comparative trial between chemical, aggregate, and no barrier

October 11, 2002

Color Legend for Building Treatment

- AGGREGATE BARRIER
- PRE CONSTRUCTION CHEMICAL TREATMENT
- NOTHING

1 inch equals 205.176473 feet

650 325 0 650 Feet

Assessment

- Termite activity around buildings
  - monthly outdoor monitoring

- Termite activity in buildings
  - quarterly building surveys

✓ Time penetrate building envelope

✓ Frequency of penetrations

✓ Location of penetrations

Data Capture / Analysis

- Developing software and data base
- WEB based (.Net technology) & SQL 2000
- ARCGIS interface
- Parameters include:
  - buildings features
  - landscape features
  - termite features

Data Capture / Analysis

- Contract with Computerra
- Initial design complete
- Awaiting hardware and software for testing
- Phase 2&3 to add building features
- Website should be available by fall 03

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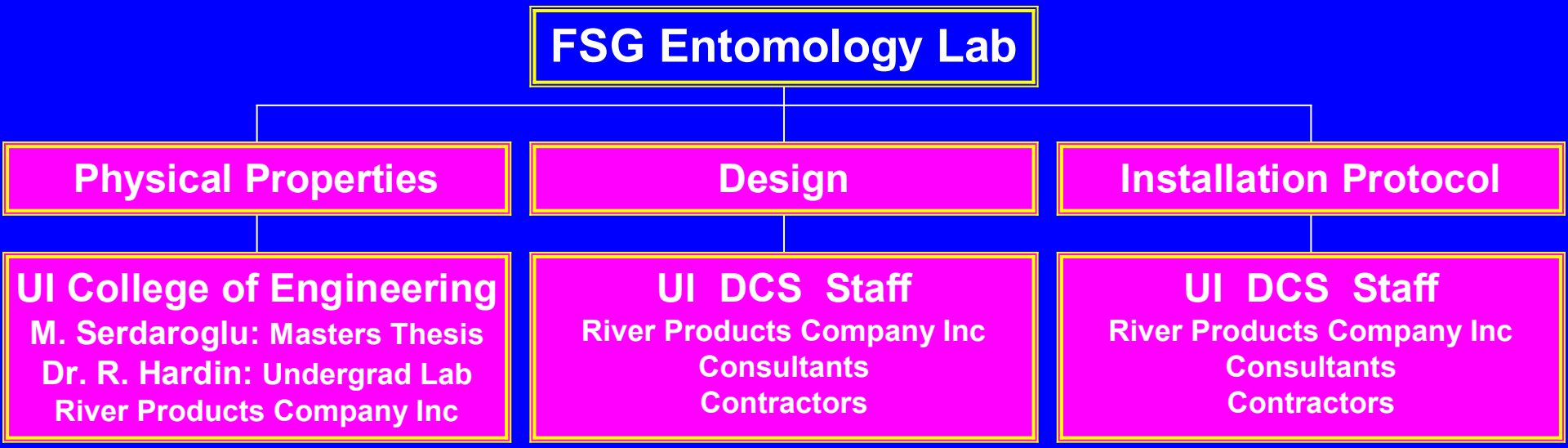
Aggregate Barrier Trials: Implementation



Implementation!

- Big construction challenges!!!
- A new process, not just backfilling
- Contamination
- Large structures
- Deep foundations
- Structural / functional performance?
  - Drainage
  - Compaction
  - ‘R’- value

Physical Properties

- **Drainage: very well drained**
  - **can replace other drainage materials (Terracon approval)**
- **Compression: exceeds loads of 400 KPa more than double required for under-slab load**
- **Compaction: some answers/some questions**
  - **prefer loose material to avoid fracture**
  - **vibrate to settle**

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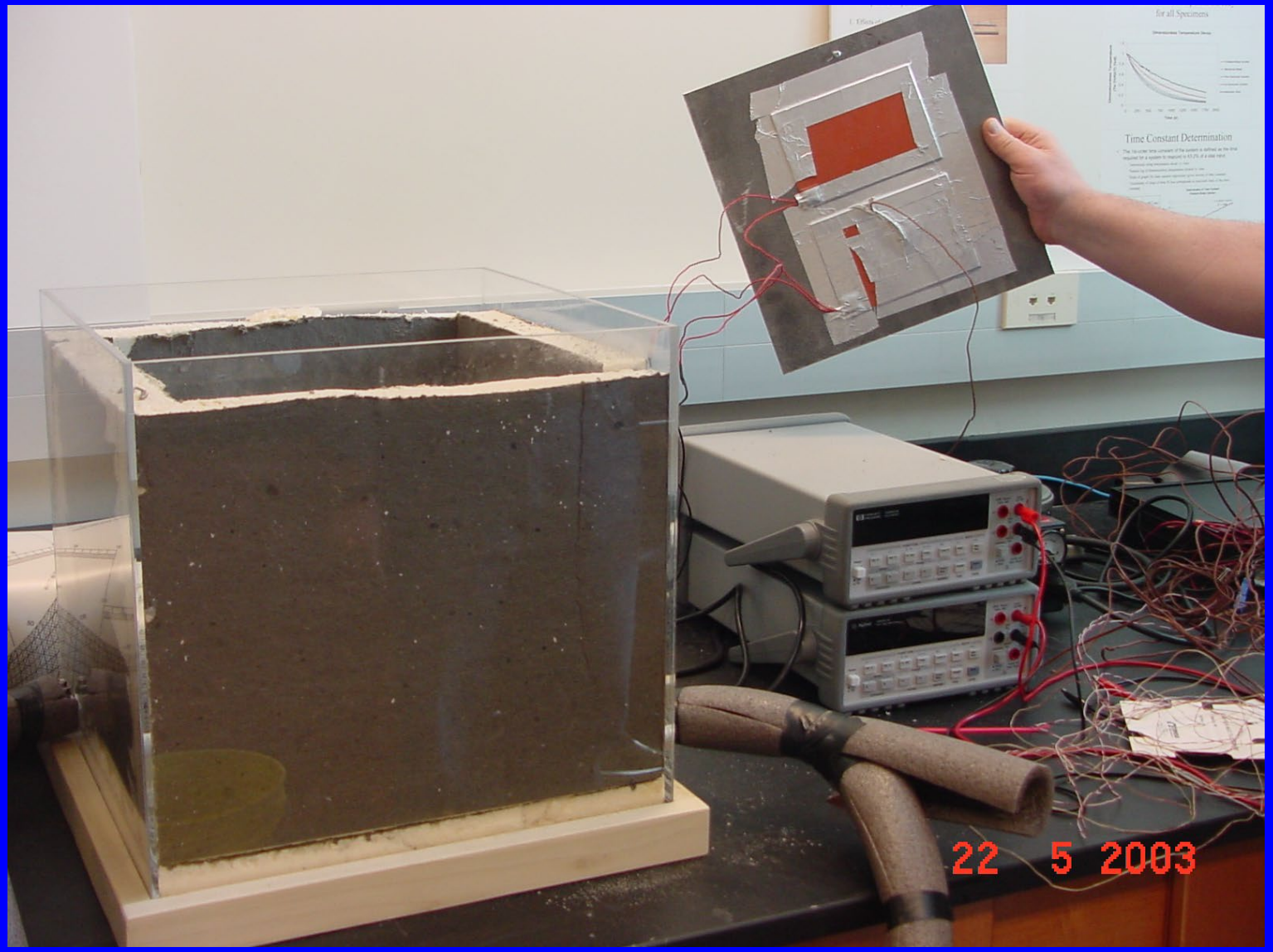
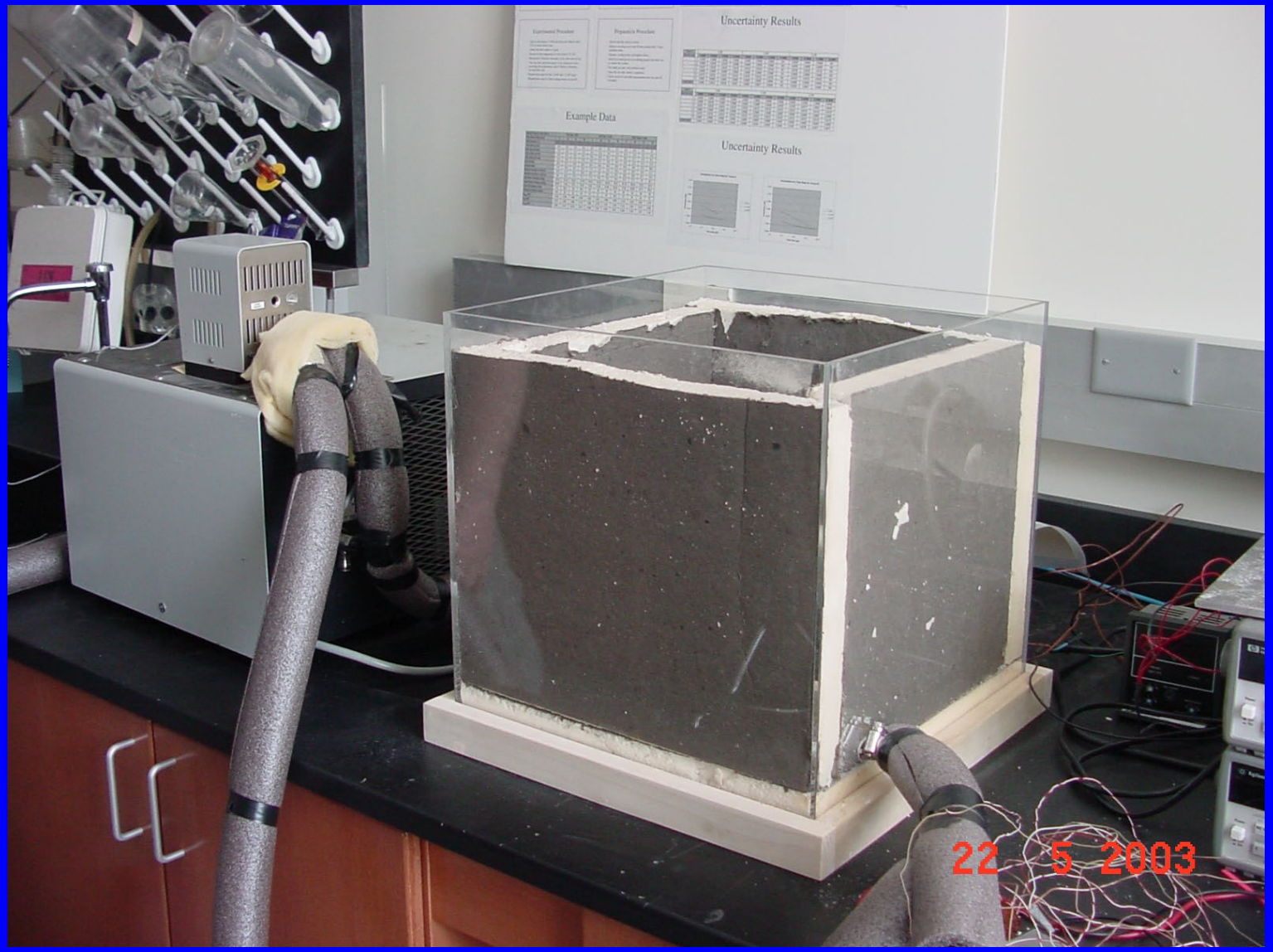
Thermal Conductivity

- Dr. Richard Hardin, UI College of Eng.
- Thermal gradient


for all Specimens
Time Constant Determination
22 5 2003


Uncertainty Results
Example Data
Uncertainty Results
22 5 2003

Thermal Conductivity

- "R-value = 5 with 7" layer
- Proceeding with design of further tests
- Calibrate with polystyrene
- Test composites (CLA and root barrier)

Maintenance!!

- Structural Longevity/Durability
  - Landscaping, water leaks
  - Renovation, Utility repairs / upgrades
  - Repair of breaches
  - Burrowing insects and mammals

- Chemical barriers face the same issues

Design Challenges

- Purity
- Longevity
- Performance
- Material Costs
- *Ease of Implementation*

Design Benefits

- Multifunctional material
  - Termite barrier
  - Insulation
  - Drainage
- Removes other costs in materials and labor
- Removes cost of chemical barriers (initial and re-application)
- Should last entire life of building

Begin with the End in Mind

- Successful physical barrier for termites
- The Key:
  - Make it a part of the building
  - Not an additional component
- Optimize for structural performance
- Maintain termite barrier qualities

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Contact Information

Bob Setter, Entomologist
The University of Iowa
260 University Services Building (USB)
Iowa City, IA 52242

Lab: 319-335-5520
Cell: 319-331-2703
Email: robert-setter@uiowa.edu