UNIVERSITY OF COLORADO
CEAE DEPARTMENT
FACULTY AND STAFF MEETING MINUTES

Date	Apr. 17, 2015	**Time**	12P – 1P
Facilitator	R. Balaji	**Scribe**	M. Hubler
Location	ECCE1B41		
Attendees	Hubler, Kasprzyk, Uleau, Jerick, Dashti, Warren, Kuchenrither, Novak, Neupauer, Zagona, Linden, Summers, Ren, Montoya, Bielefeldt, Rosario, Krarti, Znidarcic, Morris, Vasconez, Silverstein, Sideris, Corotis, Srubar, Balaji		

Key Points discussed

No.	Topic	Highlights
1	Announcements (Balaji)	• 3 seed grants: Harihar, Wil, Mija • Diane selected as campus distinguished lecturer, celebration in final faculty meeting in 2 weeks • Note Wayne's retirement party is coming up • Graduation day is on May 8th • AREN minor voting (summary by Angela) resulted in unanimous vote assuming all typos will be fixed
2	Be Boulder Anywhere (Kuchenrither)	• Proposals to make 1B41 and neighboring classroom into 'high-tech' rooms • See the attached slides for updates from BBA (formerly KATE) • BBA encourages voluntary faculty participation in updating classrooms and classes so they are providing encouragement in the form of TAs and LAs • Several advantages to BBA courses: – Opportunity for reaching more students – Make a bigger impact with teaching – Distance tuition comes back to department • Faculty should consider their courses to try distance learning
3	Department Photos (Adams)	• There will be a department photo shoot • If you have projects with students this summer for good 'action' shots with students in you lab or local fieldwork please let Emily know. • There is a new department website for which feedback is being collected and it should be done soon.
4	Research presentation by Mija Hubler	• See attached presentation.
5	Adjourn	

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Introduction to Digital Education and the Be Boulder Anywhere™ (BBA) Initiative

presented by

Jeff Luftig, Associate Vice Chancellor
&
William Kuskin, Associate Vice Provost

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Purpose:

The primary purpose of the BBA initiative is to *create a sustainable delivery platform for all distance education* delivered by University of Colorado Boulder faculty.

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Rationale (Why Us? Why Now?):

~ To *support the Chancellor's three initiatives*; especially as associated with enhancing the reputation of the University of Colorado Boulder, and acquiring new sources of revenue; and

~ To constructively *respond to requests of the President of CU and the Board of Regents* for expanding online and distance education in a way that satisfies their goals, while creating a platform that *recognizes the unique nature of the Boulder campus*.

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Approach:

Online and distance education coursework has been provided by faculty at UCB for more than 30 years, through the Division of Continuing Education and the Center for Advanced Engineering and Technology Education (CAETE), the distance learning and professional studies arm of the College of Engineering and Applied Science (CEAS). The BBA* staff will *build upon the history and structure of the existing infrastructure* in order to expand the campus portfolio of distance courses, certificates, and degree programs to *include all schools and colleges at CU Boulder*.

* As of Spring, 2015, the organization formally known as CAETE has been reorganized into the Be Boulder Anywhere administrative unit.

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Long-Term Vision:

To be *nationally recognized* as the premier delivery platform *for distance education* among all R1 public Universities in the United States.

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Mission (Through December, 2020):

- **Create Infrastructure.** Create an infrastructure capable of providing *sustainable support* for all coursework provided at a distance by CU Boulder faculty;
- **Support Existing Programs.** Continue to support and facilitate the *expansion of the existing programs* previously supported by the CAETE organization within the CEAS;
- **Expand Offerings.** Expand the portfolio of distance education coursework, certificates, and degree programs to all schools and colleges at CU Boulder *focusing on graduate education* (Professional and Existing Master's degrees);
- **Highest Quality.** Assure that all educational experiences offered at a distance through the BBA platform are of the *highest quality and effectiveness* possible; and
- **Stretch Goals**. By 2020, *extend distance education coursework* at the undergraduate and graduate levels so as to support a significant proportion of the student credit hours generated at CU Boulder.

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Operating Principles:

- **Quality**
  Our success will be measured by the expansion of high quality coursework offered at a distance by CU Boulder faculty;
- **Clients**
  Our critical clients are the academic units and faculty on the CU Boulder campus; and
- **Pull vs Push**
  Distance education coursework will be supported on a 'pull' versus 'push' basis – faculty participation is intended to be voluntary.

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Organizational Structure

Be Boulder Anywhere (BBA)

BBA Steering Committee

Russ Moore, Provost & Executive Vice Chancellor

Kelly Fox, Senior Vice Chancellor & CFO

Steve McNally

Frances Draper, Vice Chancellor – Strategic Relations

Catherine Shea, Chief of Staff

Anne Heinz, Dean, Continuing Education

Armando Pares, Assistant Dean, Continuing Education

Director
Jeffrey Luftig, Vice Chancellor for Process Innovation

Associate Director & Liaison to Continuing Education
Jannette Noonan

Director of Operations
Stephen Lawrence, Associate Professor, LSB

Internal Marketing & Communications
Quentin McAndrew

Academic Support – Office of the Provost
Michael Grant, Vice Provost and Associate Vice Chancellor for Undergraduate Education

Faculty Oversight, Program & Course Quality
William Kuskin, Associate Vice Provost for Education Innovation

Technology Support – Office of Information Technology (OIT)
Larry Levine, Associate Vice Chancellor & Chief Information Officer, CU Boulder

Academic Technology Design Group – Instructional Design & Support

Academic Technology, Classroom, Studio, and Media Support Team

Collaborative Partner: Business Development Advisory Board

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Definitions of Terms:

- **Digital Education:**

  Refers to courses offered as *online* or *distance* experiences. While all distance courses have an online component, all online courses are not necessarily distance courses.

- **Online Course:**

  Refers to pre-recorded (i.e. 'pre' ~ previous semester, term, or studio event without 'live' students) course offered without or with instructional support.

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Definitions of Terms:

- **Online Course** *(continued)***:**

  There is a continuum associated with online coursework. The Skillsoft-type programs that feature a standard PowerPoint-type presentation, associated with online quizzes, is the most basic example of an online course.

  At the other, more complex, end of the online course continuum is the *Library Course* (a CAETE/BBA term) which refers to a complete pre-recorded course, offered on a equivalent semester basis, supported by a faculty member who may or may not have been the instructor who recorded the individual lectures. This type of course is generally not offered more than one or two years after the original lectures were recorded.

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Definitions of Terms:

- **Distance Education:**

  Refers to courses offered as 'live', on-campus courses with additional sections (opportunities) for students to simultaneously take the same course either asynchronously, or both synchronously and asynchronously. These courses are often referred to as 'blended' or 'hybrid' courses. The key factor differentiating online and distance courses is the presence of a simultaneous on-campus or remote 'live' course experience.

- **Asynchronous Experience:**

  Students who participate in a course according to the same requirements and parameters as students taking the course 'live'; except they access the lectures not through attendance but by watching the recorded ('captured') lectures streamed online, or downloaded from a course website.

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Definitions of Terms:

- **Synchronous Experience:**

  Students who participate in a course according to the same requirements and parameters as students taking the course 'live'; except they 'attend' the lectures via some technological solution (e.g. Bluejeans, Go To Meeting, Webex).

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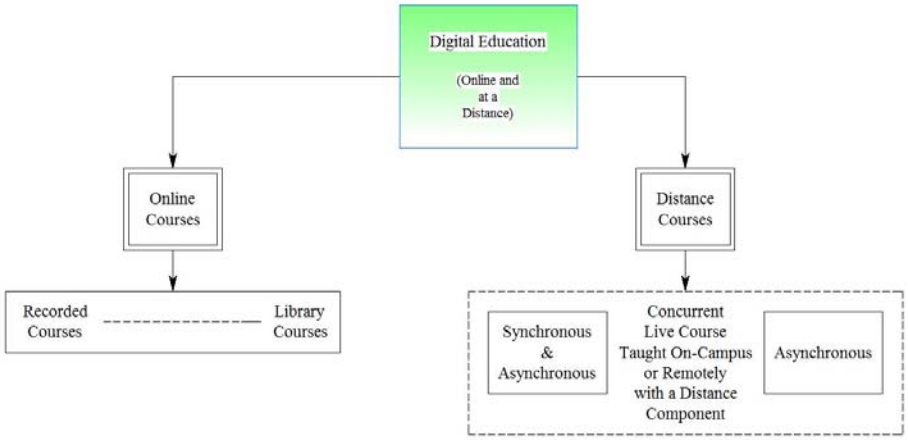
Digital Education



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Definitions of Terms:

- **Flipped Course / Classroom:**

  Typically refers to courses where students watch lectures outside of the scheduled class meeting time, and then utilize in-class time to discuss lecture content and / or engage in other learning experiences. The lectures may have been recorded by the faculty member teaching the course, or by a faculty member other than the one teaching the course. Flipped courses are rarely offered asynchronously, but it is technologically possible to do so.

- **MOOC:**

  A massive open online course (MOOC) is a model for delivering learning content online to any person who wants to take a course, with no limit on attendance (*Educause*). Historically, at least to date, MOOCs are generally not offered for academic credit, and are offered at no cost to the participant.

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Positive Aspects of Distance Courses:

- **For Remote Students** *(in no particular order of priority)*
  - Allows participation by adult learners and working professionals who cannot attend classes live;
  - Allows students who need additional time or exposure to the material to watch the lectures as many times as necessary to learn the content;
  - Affords access to remote students who wish to take a course, certificate, or degree but who cannot relocate to Colorado to do so;
  - Have the potential to eliminate waitlist issues and reduce time to degree completion;
  - Have the potential to reduce the rate of non-completers leaving before finishing their degree because they cannot register for the final one or two classes they need for graduation; and
  - May provide learning opportunities more consistent with the way students learn, as well as provide an approach consistent with their cognitive skills.

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Positive Aspects of Distance Courses:

- **For On-Campus Students** *(in no particular order of priority)*
  - Allows students who need additional time or exposure to the material to watch the lectures as many times as necessary to learn the content;
  - Eliminates the problems associated with students missing lectures due to illness or travel;
  - Have the potential to eliminate waitlist issues and reduce time to degree completion;
  - Have the potential to reduce the rate of non-completers leaving before finishing their degree because they cannot register for the final one or two classes they need for graduation; and
  - May provide learning opportunities more consistent with the way students learn, as well as provide an approach consistent with their cognitive skills.

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Positive Aspects of Distance Courses:

- **For Faculty***(in no particular order of priority)*
  - Can provide faculty with an opportunity to reach populations they would not have been able to impact otherwise; thereby
  - Improving individual, departmental, and institutional reputation;
  - Enhance the quality of the time spent with students during office hours;
  - Improve student success and assist in the initiative to increase retention rates;
  - Improve the opportunities to teach important courses which often are cancelled due to low (on-campus) enrollment rates;
  - Improve student evaluations of instruction; and
  - Faculty have the opportunity to learn additional forms of instructional technology in a well-supported environment.

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Techniques & Issues - Teaching Distance Courses:

- Can a seminar-type course be offered synchronously?
- What are some difference in teaching to a live audience, and for teaching distance courses?
  - Believe it or not, teaching asynchronous students is more challenging than teaching students who participate synchronously;
  - Use of multiple multimedia sources tends to improve student experiences;
  - Remembering to 'include' asynchronous audience is critical;
  - Use of technology for synchronous office hours / recitation sessions can significantly improve the educational experience; ultimately,
  - It is critical to offer the same value proposition to remote students as we offer to on campus students.

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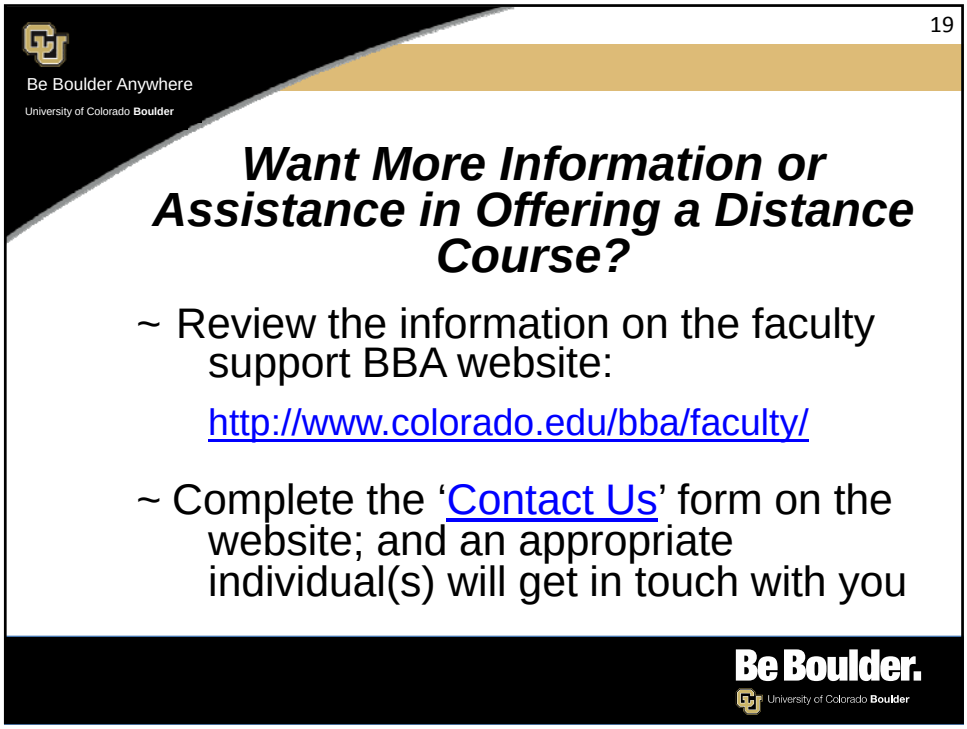
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Want More Information or Assistance in Offering a Distance Course?
~ Review the information on the faculty support BBA website:
http://www.colorado.edu/bba/faculty/
~ Complete the 'Contact Us' form on the website; and an appropriate individual(s) will get in touch with you
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RESEARCH SUMMARY
MIJA HUBLER

Assistant Professor
Structural Engineering and Structural Mechanics

Faculty Meeting 4/15/2015

Background

- Education: structural engineering
- Expertise: fracture mechanics, transport phenomena, structural design, statistics, failure theory
- Application: microstructure design for civil infrastructure
  - Concrete infrastructure sustainability: improved durability and lifetime
  - Improved construction materials testing: direct correlations with response, cost-efficient
  - Application specific material design and analysis

(ex. When will fracture occur and how can we control it?)

Outline

- Past projects
- Recent work
- Current projects

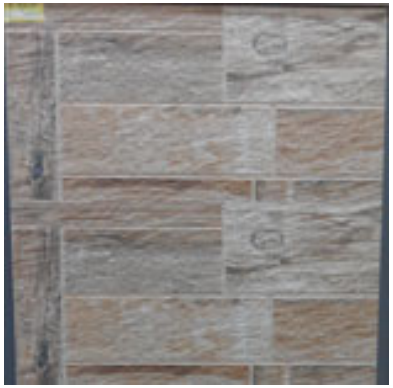
Outline

- **Past projects (3)**
- Recent work
- Conclusions and current projects

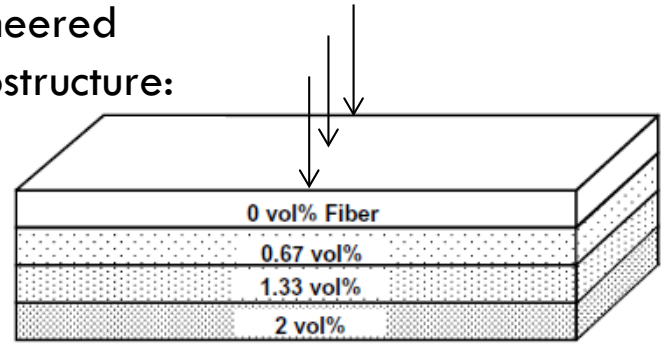
Fiber-Reinforced Concrete

- Can we provide a low-cost, application engineered cement tile product?
- Challenges: modern fiber reinforced cements are expensive and lack practical applications
- Concept: let's engineer the microstructure for specific applications

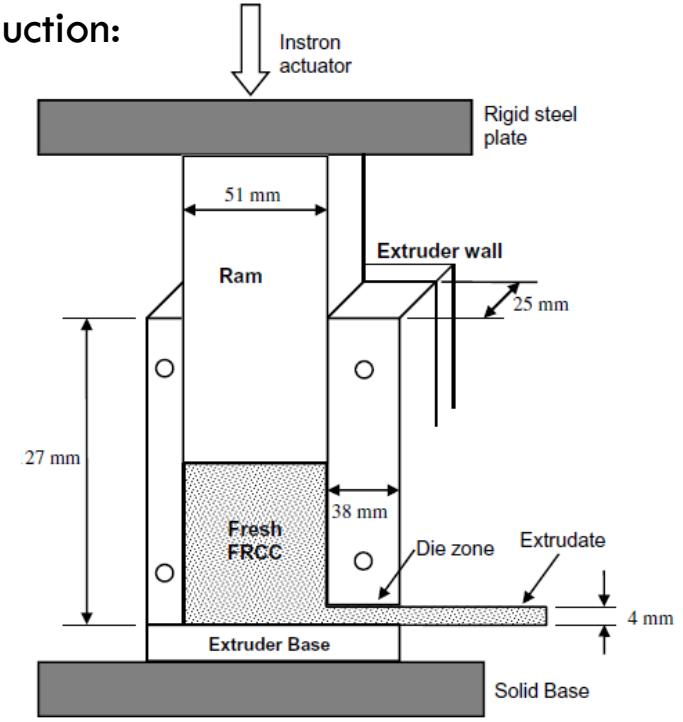
A residential ceramic tile:



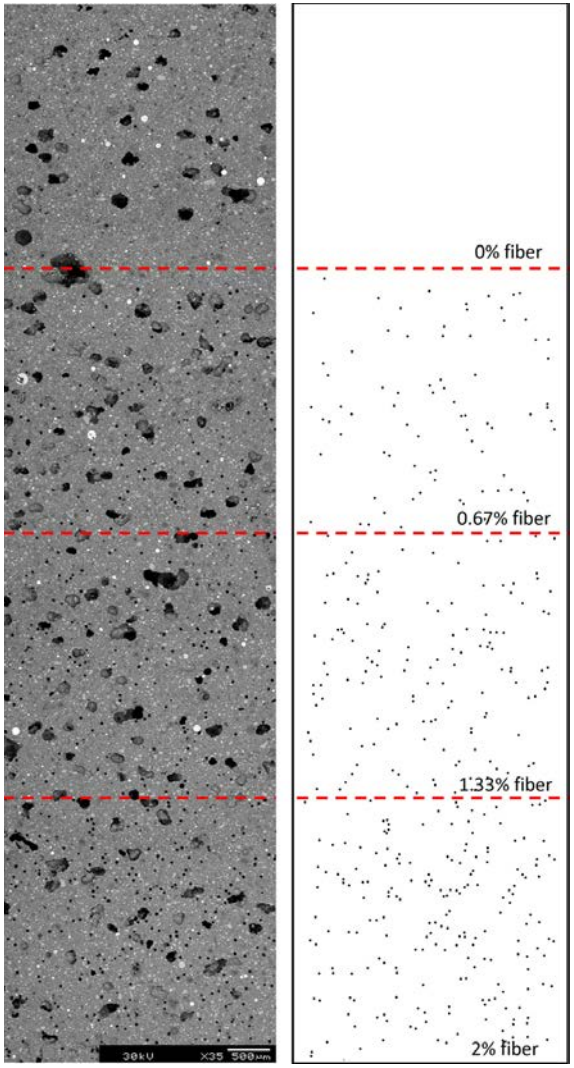
Engineered microstructure:



Production:

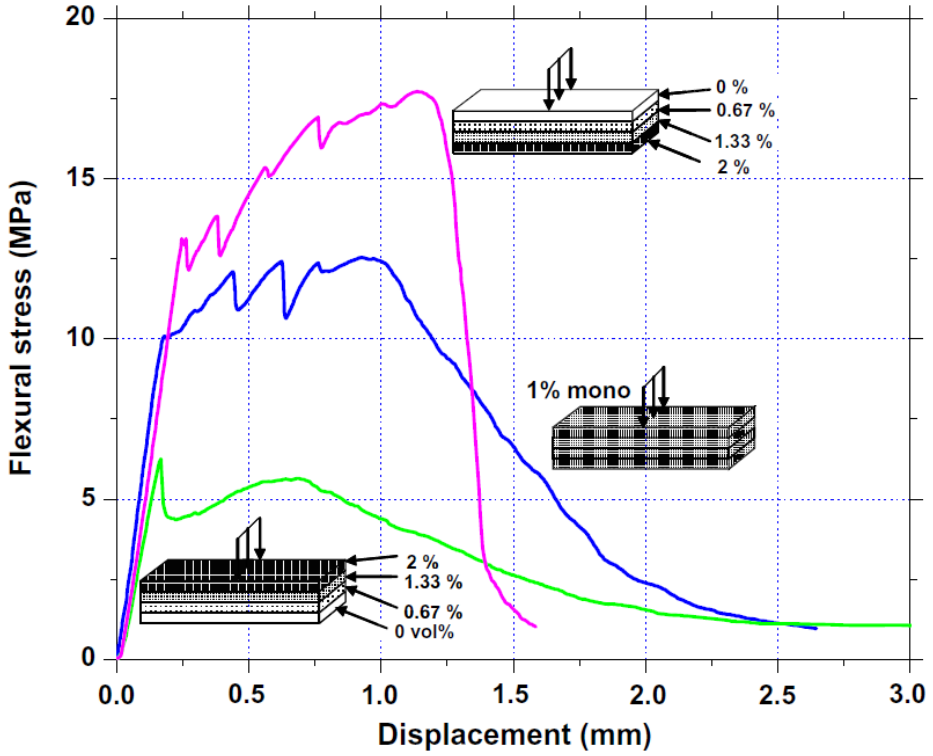


Fiber-Reinforced Concrete



Check: backscatter SEM imaging, shape recognition

Results:

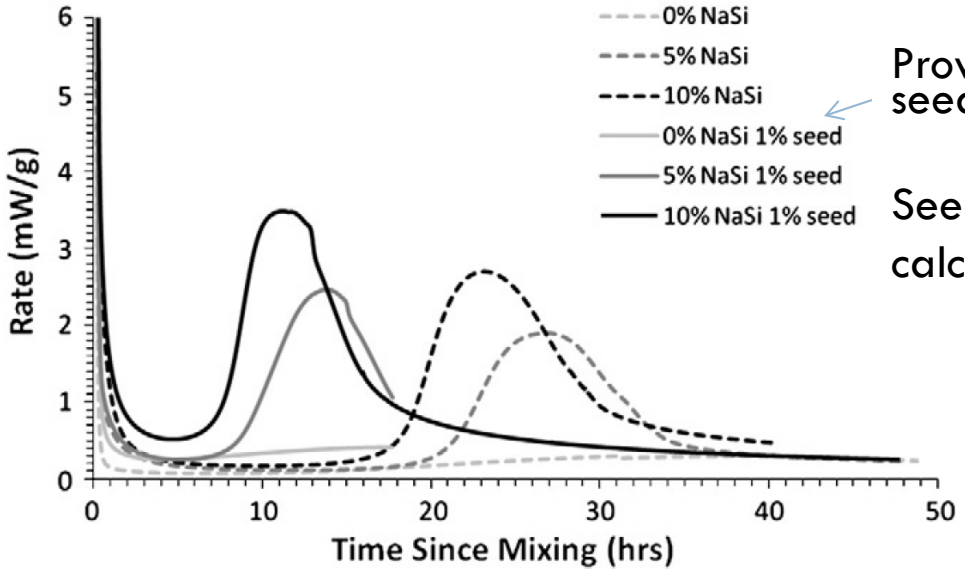


Note: common claims of improved corrosion resistance for similar materials in bridges, but would require design of pore network discontinuity (not pixie dust).

Nucleation Seeding of Geopolymers

- Can we use slag waste cement (geopolymer) as a replacement for ordinary Portland cement?
- Challenges: the hydration rate is slow which causes construction issues
- Concept: let's engineer the microstructure for faster hydration

Isothermal calorimetry



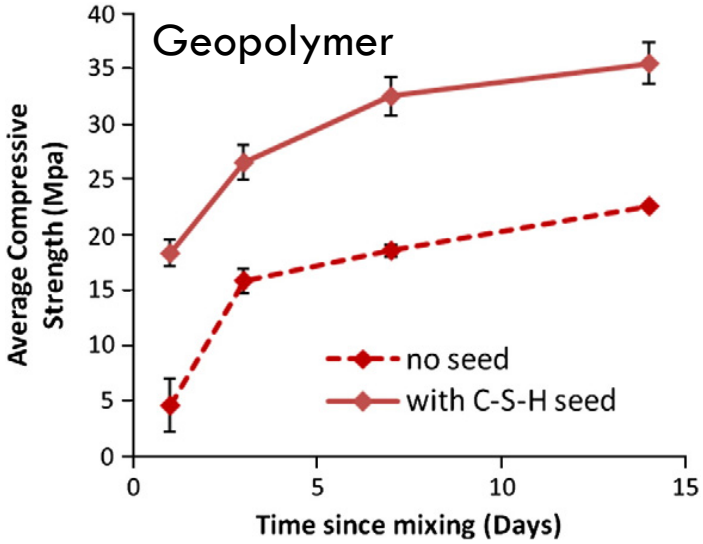
Provides sites for nucleation seeding growth mechanism

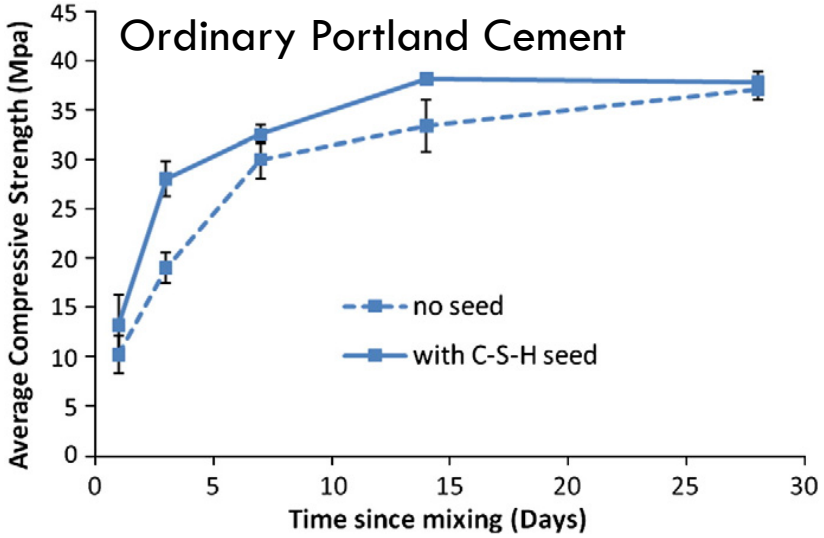
Seed: laboratory-made calcium silica hydrate gel

Heat of hydration quantifies reaction rate and strength development.

Nucleation Seeding of Geopolymers

Results:





Note: A more dense matrix affects transport phenomena and makes the cement more sensitive to humidity profiles while curing. Traditionally moist curing is favorable, not here.

Multi-Decade Creep of Bridges

- Can we explain why bridges are deflecting beyond current design code predictions?
- Challenges: legally hard to acquire data, we are not sure of the cause
- Concept: could it be due to our understanding of aging cement microstructure

Why we suspect material behavior:

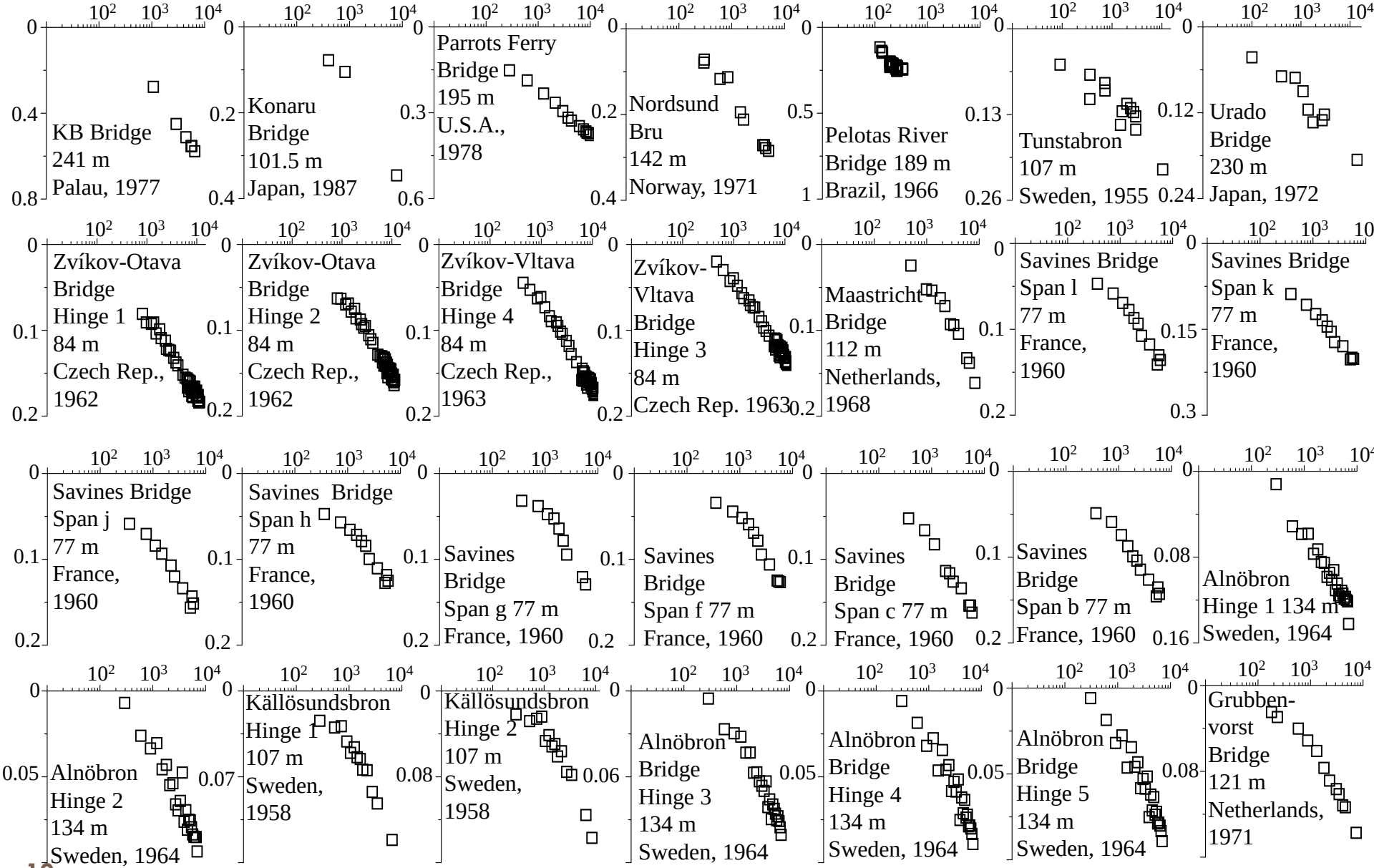
- Creep and Shrinkage: Hard to test
- Dealing with uncertainty
- International design equations don't agree.

Creep testing at CTL lab

KB Bridge: Palau

Collapsed in 1996, numerical simulation calibrated with experimental material behavior much closer to real response than any design code.

A Global Phenomena – 69 Bridges



[Deflection/Span (%)] vs. Time Elapsed (days, log-scale)

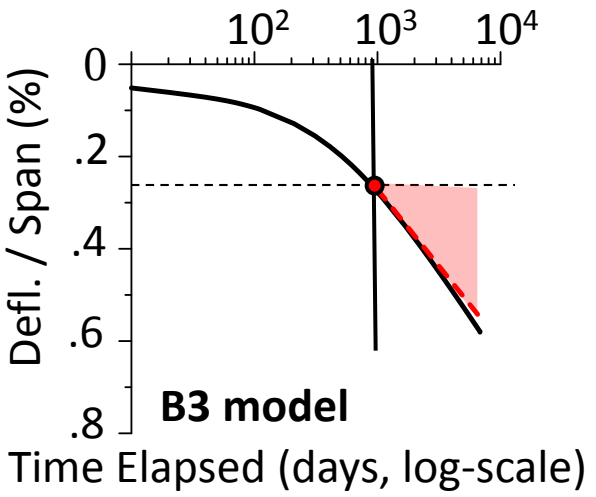
Multi-Decade Creep of Bridges

Let's estimate how far off the design code material compliance equations are.

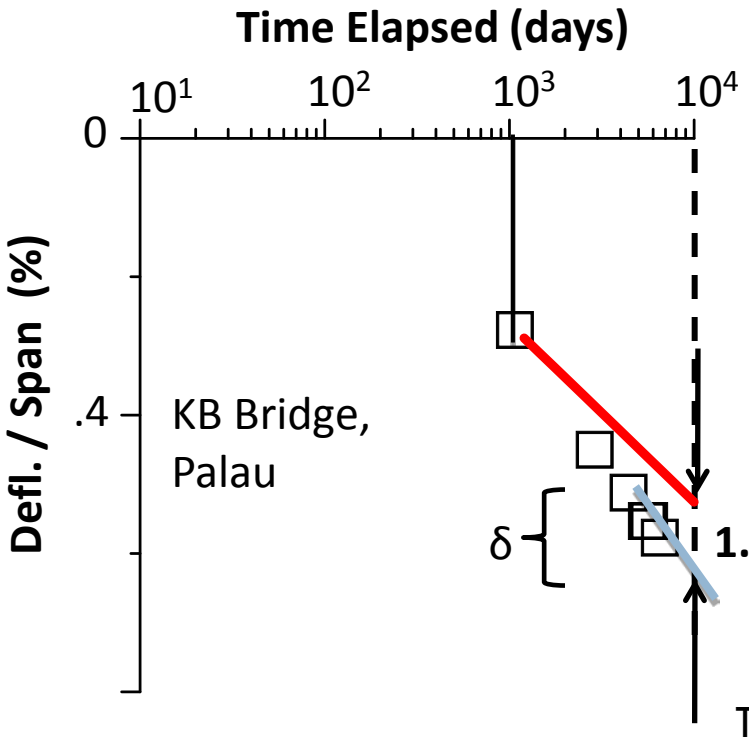
- Assumptions: After 3 years (t_{ref}) the complex effects of
  - drying,
  - construction sequence,
  - differences in age,
  - thickness and environmental exposure, etc., almost die out.
- Approximate Prediction:

$$u(t) \approx u_{ref} \frac{J(t,t_a) - J(t_c,t_a)}{J(t_{ref},t_a) - J(t_c,t_a)}$$

u_{ref} – measured deflection
$J(t,t')$ – model creep function (ACI, CEB, or B3)
t_a – average age at load application
t_c – average age at closing of the bridge span



Multi-Decade Creep of Bridges



Example: Systematic underestimation with the B3 model

Average error considering all 69 bridges

This is significant so lets fix it!

- Material volume changes while in service due to:
  - applied stress (mechanical and environmental) and ⇨ **CREEP**
  - changes of internal structure and composition (from hydration and degradation). ⇨ **SHRINKAGE**

Multi-Decade Creep of Bridges

- Joint statistical optimization of laboratory test database and bridge measurements
- Improved rheological model based on nonlinear diffusion

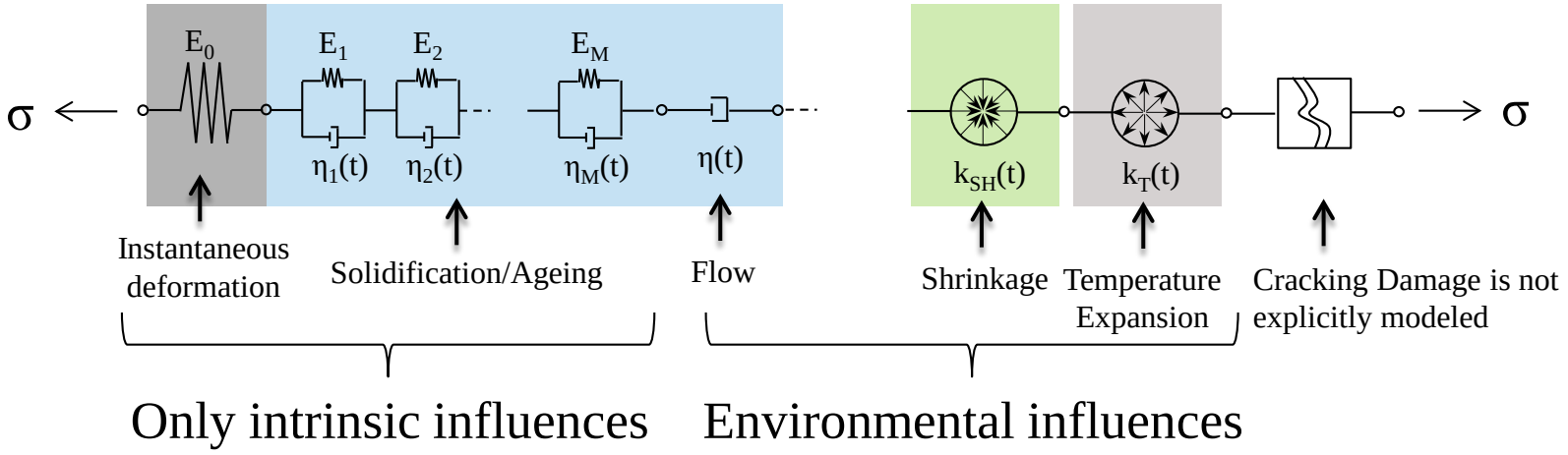
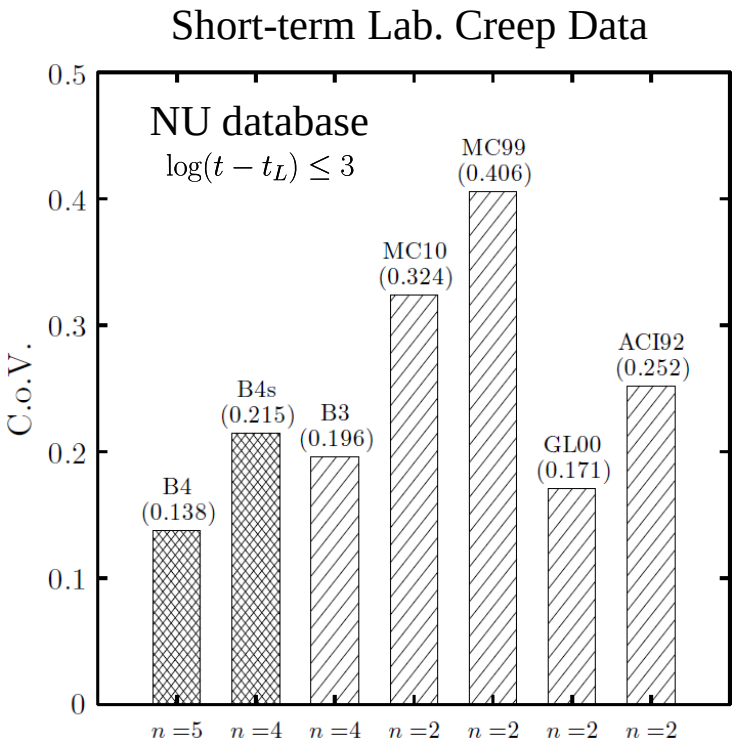


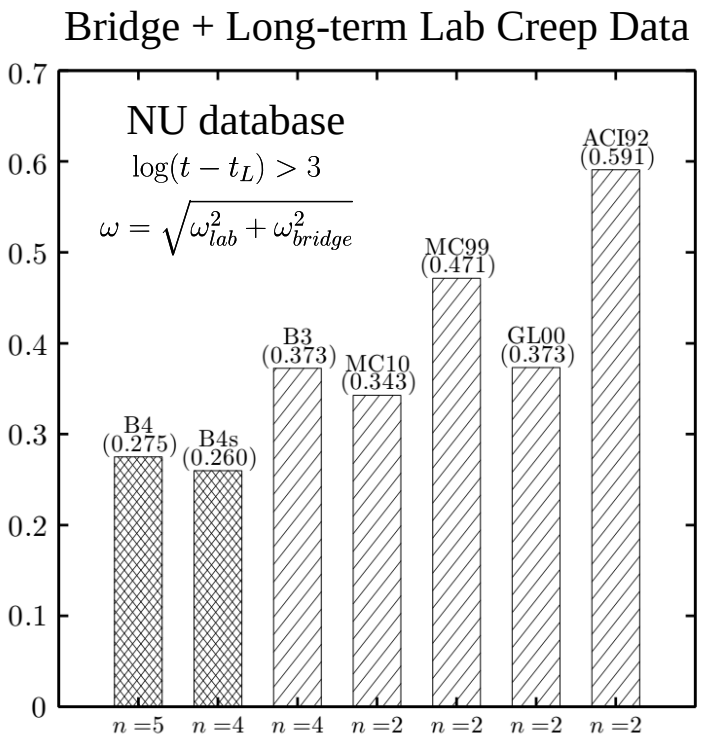
*Illustration instead of pages of formulas

Multi-Decade Creep of Bridges

Result: new concrete section design model for creep and shrinkage



1377 data sets



Note: voted as new recommendation of international RILEM committee last year.

Outline

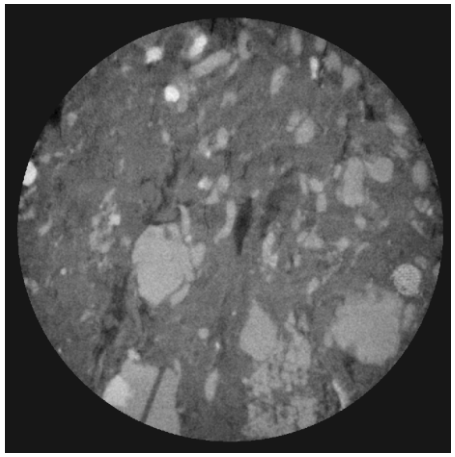
- Past projects
- **Recent work (2)**
- Conclusions and current projects

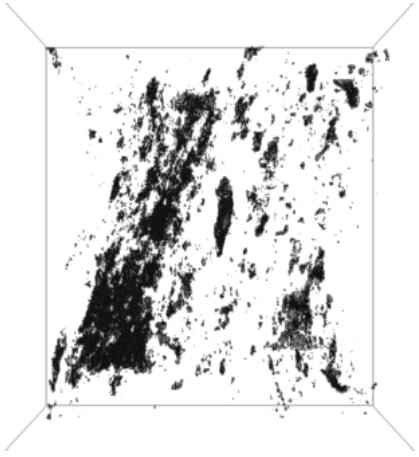
A Better Understanding of Gas Shale

How can engineers consistently quantify gas shale productivity and mechanical behavior?

Challenges: shale is hard to reach, large scale testing uncertainties cost money and cause safety concerns

Concept: let's quantify the microstructure and how it fails





Rock maturity = hydrocarbon potential (degree organic has turned into carbons)

*defines a system state due to history of energy input and thus entropy evolution

→ Similar to cement extrusion with fibers, inclusions and pores are arranged in the structure

→ Should be able to use spatial statistics of the microstructure and fracture mechanics based testing

Check: XRM imaging with 65µm volume, new segmentation procedure based on NIST x-ray attenuation database

→ Shown to have representative volume fractions to bulk material measurements

A Better Understanding of Gas Shale

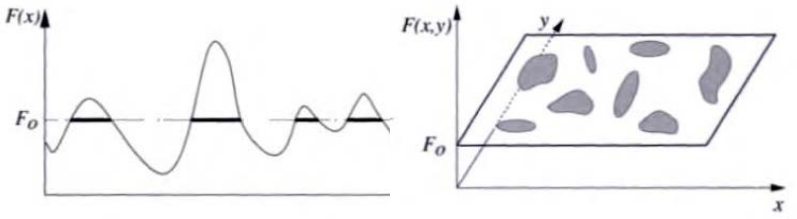
Note: These data allow for numerical investigations of permeability and mechanical behavior.

Microstructure Reconstruction

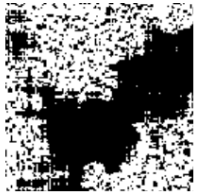
inclusions

clay

$f(\mathbf{x}) = \Sigma_{n=1}^{N} f_n \delta(\mathbf{x} - \mathbf{x}_n)$ convolution filter

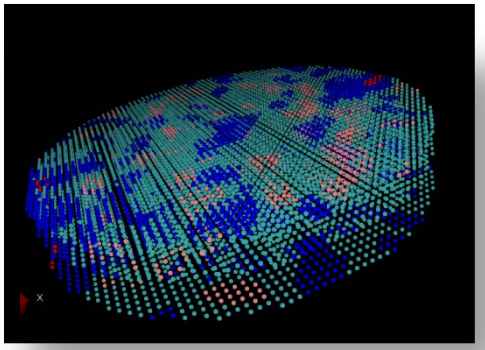


inclusions



clay

$E = \sum_i [f_s(r_i) - f_0(r_i)]^2$ mean error function

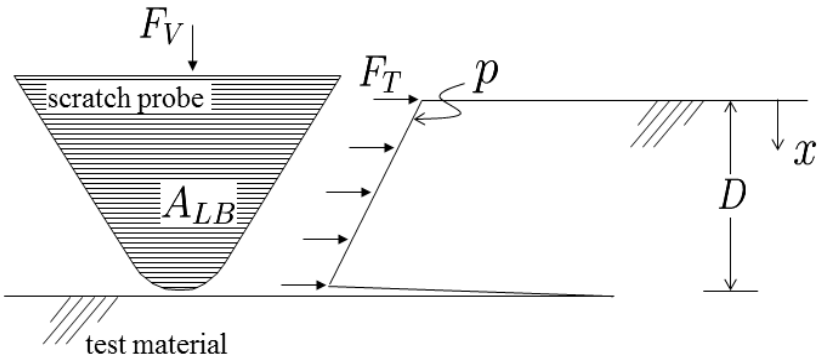


Systematically study role of microstructure considering maturity w/o expensive samples

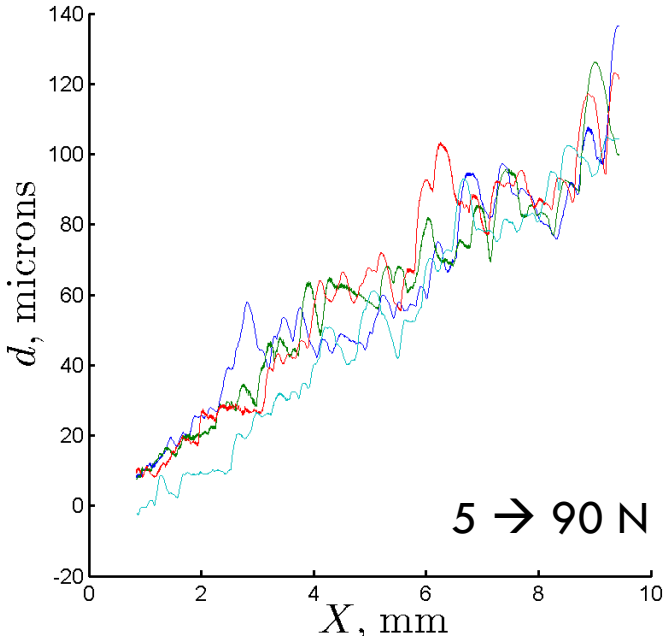
→ particle model using interaction LJ potentials in LAAMPS

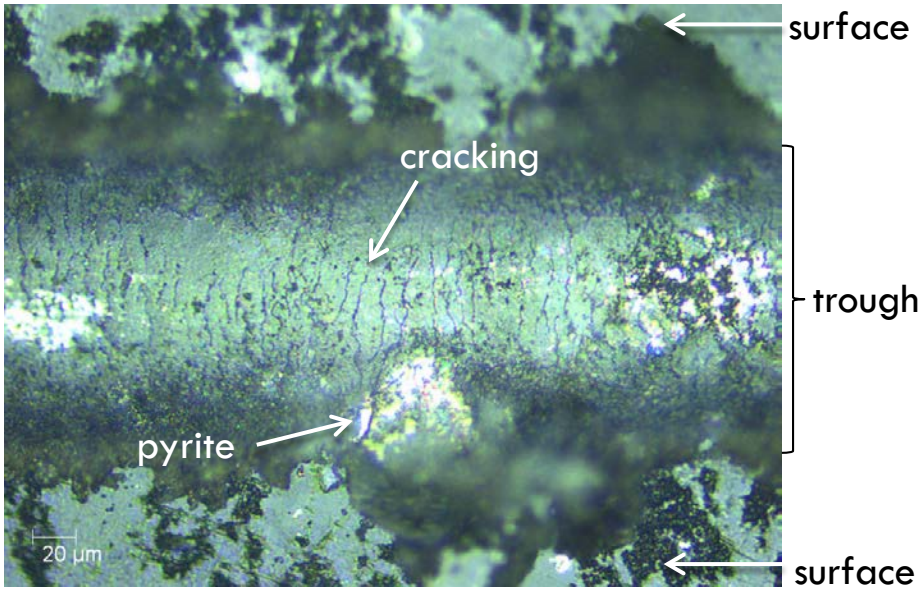
→ Compare to test data

Micro-scale testing



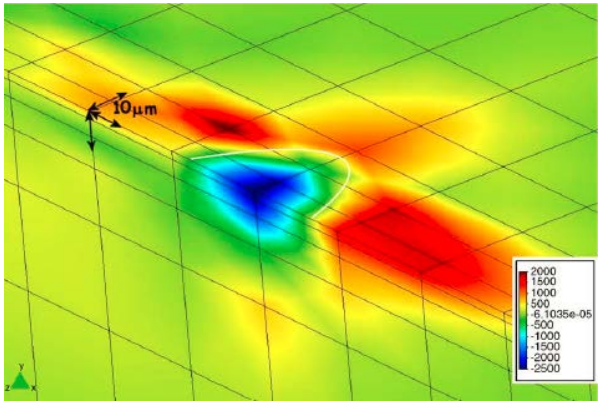
1. Polish material surface
2. Scratch surface (Rockwell indenter) at force F_V
3. Measure depth, D, and resisting force, F_T
4. Relate these to mechanical quantities

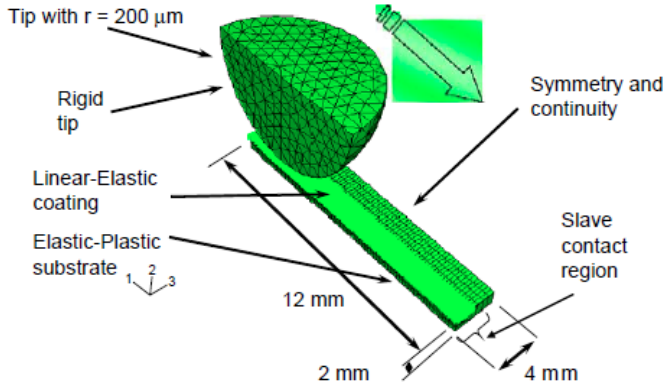




Micro-scale testing

- Micro-scratch testing of materials
  (Wredenberg and Larson 2009) (Richard et al 1998) (Ollendorf and Schneider 1999)
- Computational modeling of scratch testing of homogeneous materials
  (Holmberg et al. Surface & Coating Tech. 200, 2006):

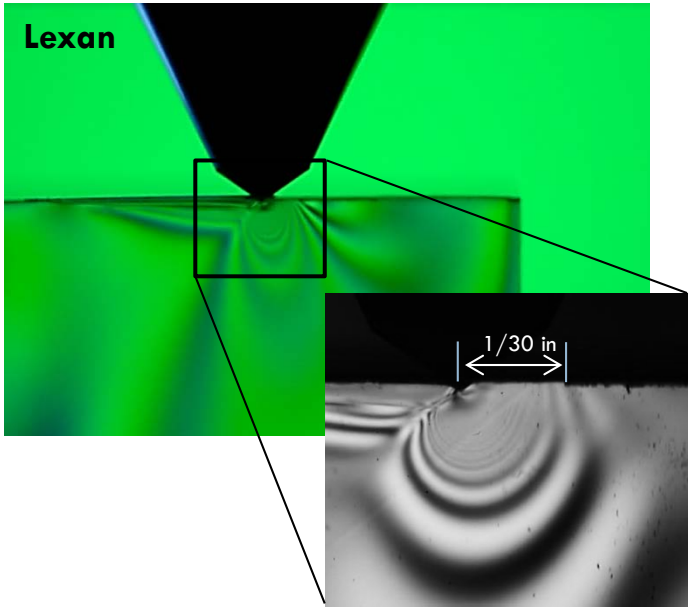


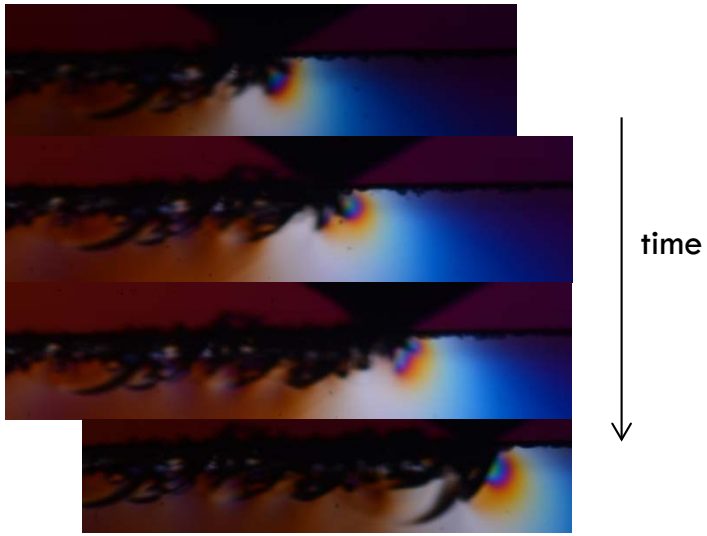


- Scratch testing of shale w/ linear elasticity
  (Akono thesis 2013)

But shale is not linear elastic!

Micro-scale testing



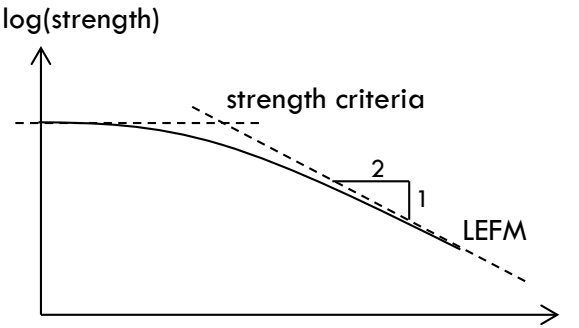


Photoelastic imaging

Cement/ Ceramics/Rock/Ice

Quasibrittle material: the nonlinear zone (microcracking & softening) ahead of the stress concentration is large compared to the problem dimensions.

Size effect analysis: combines failure tests of various sizes according to energy scaling relations, captures transition from ductile to brittle response

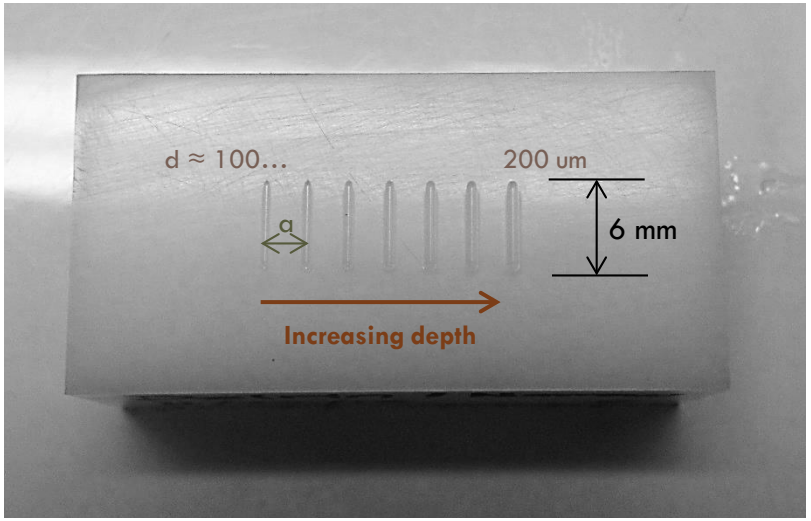


Test various size samples to get points on curve →

Micro-scale testing

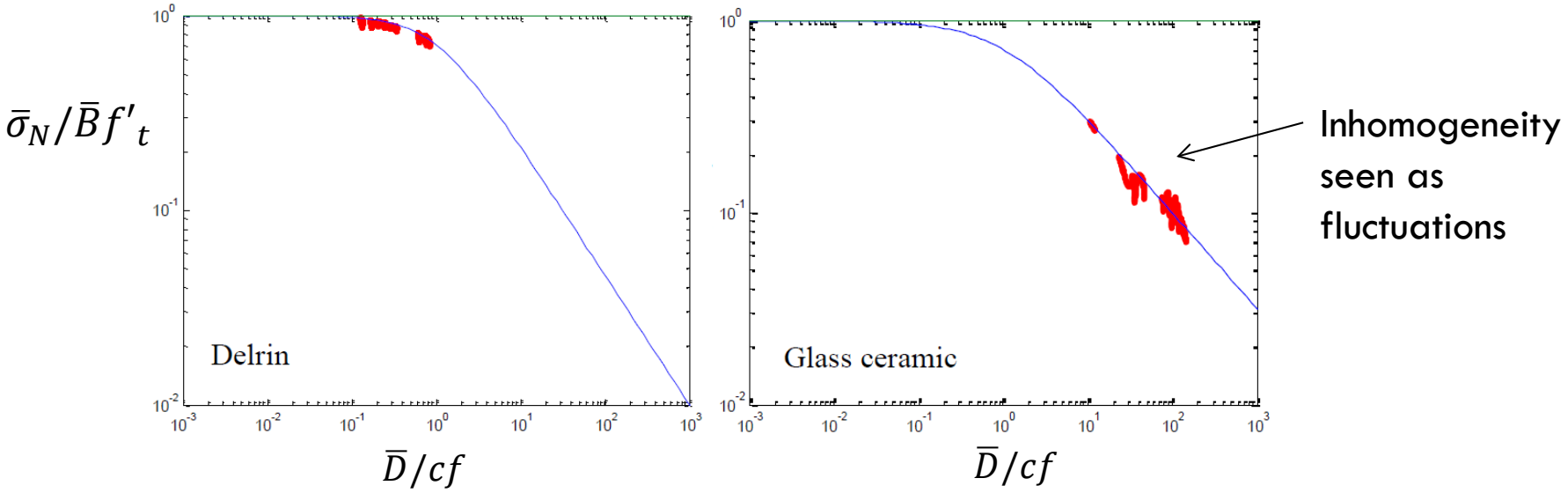
Experimental Framework

1. Polish sample to down to 1µm
2. Select a series of at least 6 equally spaced depths. One test should be performed as far from the LEFM limit as possible, and all depths should cover at least 5-10 times the maximum inclusion size.
3. Each scratch should be repeated at least 6 times.
4. If needed perform a systematic high frequency filtering to reduce noise and remove outliers.
5. Perform the size effect computational procedure on the force vs depth data.



Micro-scale testing

Results:



- Can obtain fracture toughness and characteristic length scale of the material
- Typical size effect testing for concrete requires much larger experimental investigations performed in the structures lab
- Direct confirmation of numerical models

Outline

- Past projects
- Recent work
- **Current projects**

Current projects

- Can we improve *transport models* and *test methods* for construction materials to create longer lasting infrastructure? (potential projects with Prof. Yu at U of Pitts. And Prof. Xi)
- Further development of micro-scale testing methods: quantify coefficient of friction. (developing mico-scale testing lab with Anton Paar)
- Can we engineer concrete and concrete structures to fail in particular particle sizes and shapes to create less toxic post-collapse environments? (CU Seed grant collaboration with Prof. Montoya and School of Pharmacy at Anschutz Medical Campus)

Publications

- B. Shen, **M. Hubler**, G. Paulino, and L. Struble, "Functionally-graded fiber-reinforced cement composite: Processing, microstructure, and properties," Cement & Concrete Composites. 2008, 30 pg. 663-673.
- **Hubler, M H.**, Jeffrey J. Thomas, and Hamlin M. Jennings. "Influence of nucleation seeding on the hydration kinetics and compressive strength of alkali activated slag paste." *Cement and Concrete Research* 41.8 2011: 842-846.
- Z. Bažant, **M. Hubler**, and Q. Yu, "Excessive Creep Deflections: An Awakening," Concrete International. 2011, 33(8), pg. 44-46.
- Z. Bažant, **M. Hubler**, and Q. Yu, "Pervasiveness of Excessive Segmental Bridge Deflections: Wake-Up Call for Creep," ACI Structural J. 2011, 108(6), pg. 766-774.
- **M. Hubler**, R. Wendner, and Z. Bažant, "Extensive Concrete Creep and Shrinkage Database – Analysis and Recommendations for Testing and Reporting," ACI Mat. J, 2014
- RILEM TC-242-MDC, "RILEM draft recommendation: TC-242-MDC multi-decade creep and shrinkage of concrete: material model and structural analysis*," RILEM Mater. and Struc., 48(4), 2015.
- R. Wendner, **M. H. Hubler**, and Z. Bažant, "Optimization method, choice of form and uncertainty quantification of Model B4 using laboratory and multi-decade bridge databases," RILEM Mater. and Struc., 48(4), 2015.
- **M. H. Hubler**, R. Wendner, and Z. Bažant, "Statistical justification of Model B4 for drying and autogenous shrinkage of concrete and comparisons to other models," RILEM Mater. and Struc., 48(4), 2015.
- R. Wendner, **M. H. Hubler**, and Z. Bažant, "Statistical justification of model B4 for multi-decade concrete creep using laboratory and bridge databases and comparisons to other models," RILEM Mater. and Struc., 48(4), 2015.
- **M. H. Hubler**, R. Wendner, and Z. Bažant, "Extensive Concrete Creep and Shrinkage Database – Analysis and Recommendations for Testing and Reporting," in press for ACI Mat. J, 2015

Thank you