Long Term Assessment of Dams Suffering from Alkali Aggregate Reaction

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Agreement

Reclamation has *Assistance Agreement* R18AC00055 with the Dept. of Civil Engineering at the University of Colorado (Boulder) on Long Term Assessment of Dams Suffering from Alkali Aggregate Reaction

Purpose

...Provide the engineering community wide benefits that include the identification of the elements needed to perform structural evaluations of dams affected by ASR, facilitate risk estimations, including enhancing risk analysis protocols that will assist the operators and managers of dams with key data to make decisions regarding safe operation of the dams affected by alkali silica reactivity.
Introduction

Scope of Work

- Literature Review and Database for the comprehensive assessment of a generic curved dam suffering from AAR; shall include searchable document-oriented database of relevant documents. Report 1: Structural Safety and Integrity Assessment of Dams Suffering from AAR; A State of the Art Report

- Comprehensive Assessment Methodology: Develop detailed research methodology for the comprehensive assessment of a generic curved dam suffering from AAR using probabilistic/stochastic methods. Report 2: Road Map for the Structural Assessment of Concrete Dams suffering from AAR with Specific Application to Seminoe Dam

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Introduction

Scope of Work

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Introduction

Today’s Presentation

- Results of year one:
  - Literature survey
  - Road Map.

- Highlights of a stochastic analysis of a dam suffering from AAR.

- Three documents under review.

Long Term Assessment of Dams Suffering from Alkali Aggregate Reaction;

State of the Art Review

Dam Safety Technology Development Program

U.S. Department of the Interior
Bureau of Reclamation
Technical Service Center
Denver, Colorado

April 2019
Identified 600 publications from Google Scholar with a variety of keywords. Reduce it to ∼ 400 focusing on structures with existing AAR. Further reduced to ∼ 210 based on reading Abstracts and Conclusions. Included about 50 additional publications suggested by Reclamation. Updated spreadsheet table with key information.

<table>
<thead>
<tr>
<th>Labels</th>
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<th>Availability</th>
<th>Keywords</th>
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Keywords

<table>
<thead>
<tr>
<th>ID</th>
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<td>Blocks;</td>
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<td>Multi scale;</td>
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<td>14</td>
<td>Other;</td>
<td>54</td>
<td>New constitutive model;</td>
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<tr>
<td>15</td>
<td>Expansion Assessment/monitoring</td>
<td>55</td>
<td>Nonlinear;</td>
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<tr>
<td>16</td>
<td>Reinforcement</td>
<td>56</td>
<td>Coupled;</td>
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</tbody>
</table>
Environment is very flexible and not restricted to any specific application.

Can easily add new entries to the data base
- Minimum requirement: bibtex entry with keywords.
- Additional possible ones: full paper and/or card

1. Identify publications
2. Collect pdfs
3. Read document
4. Get title, and search Google Scholar for a `\texttt{BIBTEX}` entry.
5. Log in the reference in a spreadsheet, assign (numeral) keywords and url links to each entry.
6. Coalesce the original `\texttt{BIBTEX}` and the Excel file into an updated `\texttt{BIBTEX}` file that contains (textual) entries for keywords and urls.
7. Write a card summarizing major findings of the documents (in bulleted form, possibly with figures).
8. Generate a final pdf report with all card entries.
9. Provide full documents, cards and updated `\texttt{BIBTEX}` files to SEN4AAR (see below) for web based queries.

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8/23
3.8 Bangert, F and Kuhl, D and Meschke, G (2004) URL

@article{bangert2004chemo, label={bangert2004chemo}, title={Chemo-hygro-mechanical modelling and numerical simulation of concrete deterioration caused by alkali-silica reaction}, author={Bangert, F and Kuhl, D and Meschke, G}, journal={International Journal for Numerical and Analytical Methods in Geomechanics}, volume={28}, number={7-8}, pages={689--714}, year={2004}, publisher={Wiley Online Library} Keywords={Laboratory; Expansion monitoring; Petrography; SEM }

- The three-point bending test is performed on a 2D beam with a length of 64 cm and a height of 16 cm.
- Numerical simulations are performed in plane strain mode.
- The beam is subjected to a time-dependent hygral loading, as well as boundary conditions for 300 days.
- Figure 3.12 shows the time-dependent behavior of the beam with four characteristics:
  - $t = 20$ days corresponds to the end of the initial drying process. Due to the drying at the surface, the ASR shifts to the more humid inner parts.
  - Subsequently, the inner part of the beam is subjected to compression while the outer part is subjected to tension. These tensile stresses cause cracking along the surface.
  - $t = 40$ to 120 days corresponds to the wetting process characterized by a moisture transport oriented from the bottom toward the top.
  - $t = 140$ to 300 days corresponds to hygral unloading. Since only marginal changes of the damage state are observed, the ASR has almost completely come to an end.

- The evolution of the ASR expansion in three points along the axis of symmetry, as well as the capacity curves for the sound and ASR-affected beams, are shown in Figure 3.13.
- This shows that the ASR-induced expansion (and, consequently, the deterioration of concrete structures caused by the ASR) strongly depends on the moisture content and on the hygral loading history.
- The beam is subjected to the time-dependent hygral loading, as well as boundary conditions, for 300 days.
- At the end of $t = 300$ days, the structural stiffness is reduced by $1 - \frac{E_{300}}{E_0} = 55\%$ due to the ASR.

- URL to directly link to the full document (restrictions apply).
- Updated \textsc{\texttt{BibTeX}} entry with many tags.
- Summary of document.
- A total of $\sim 240$ “cards”
Objective

- Offer low barrier to access specific information from a literature survey or set of PDF documents.
- Enrich search results with supplementary information from summary cards and bibtex meta data.
- Offer visualizations on search results to give insight into result without needing to read its entirety.
Technologies Used

Overview

- Full-Text Search Engine - ElasticSearch
- Automatic Document Preprocessor - In-house Python Program
- Search Backend Interface - In-house Python Program
- Data Visualization - JavaScript Extending D3.js and p5.js
- User Interface and Experience - In-house Python, HTML, JavaScript, CSS

Processed JSON

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{
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    "Zhang, Chengzh",
    "Wang, Alqin",
    "Tong, Mingshu",
    "Wu, Bingqin",
    "Zhang, Mingsheng"
  ],
  "displaypdf": "0",
  "document": "Cement and Concrete Research 29 (1999) 1393-1401: expansion Chengzh Zhang,*, Aiqin Wang, Mingshu Tong, Bing China Institute of Water Resources and Hydropower Research, Beijing Science and Engineering, Nanjing University of Chemical Technology, Plant of Jiangsu Province, Wuxi 214021, People’s Republic of China Construction Committee, Fushan 528000, People’s Republic of China. Influences of aggregate size and aggregate size grading on ASR that the effect of the addition of coarse aggregate on the expansion may be promoting expansion. Moreover, its effect that the effect of coarse aggregate on the expansion of aggregate is and mortar mix. From the results of experimental, the alkali-reactivity of aggregate, single-size aggregate grading is reserved. Keywords: Aggregate size; Aggregate size grading; ASR. Introduction It is well known that ASR expansion is related to the mortar bar with reactive siliceous aggregate increases as the particle size smaller than 20 nm increases continuously when the particle size smaller than 20 nm increases.
```
Technologies Used

Information Flow

Technical Flow Between Components

- Ingest BibTex Entry, Publication, and Card
- Trigger Parser → Parse into JSON
- JSON → Feed ElasticSearch
- ElasticSearch → Admin
- Add Bibtex, Publication, Card
- Admin → User Creation, Deletion, Promotion, Verification
- SQLite
- Python
- Admin View
- Search View
- Javascript → D3.js
- HTML, Javascript, CSS

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Intuitive search application; a simple search box with a submit button.

Returns search results with highlights.

Visualize information within search results.
Program Features

User Management

- Allow **access control** over entire or part of application.
- User **creation and deletion**.
- User **promotion and demotion to/from multiple tiers** of super users.
- Immediate access for .edu, .gov, and .mil emails with **configurable domain extensions**.

![SEN4AAR](image-url)

**Manage Users**

Pending Registrations:
- testaccount | Approve | Deny

Users:
- aloisama |
- saouma |
- alsaffar | Promote to Superuser | Promote to Admin
Add PDF documents, summaries, and BibTeX meta data to program.

Bare minimum is a BibTeX entry

Better results if publication PDF and keywords provided.

Respects copyright while still providing relevant search results and summary cards.

Allow specific users unconditional access to all documents.
Program Features

- Orthogonal development
- Flexible future movement in any direction
- Natural Language Processing
- Add more visualizations
- Expand to broader/different topics and fields where full-text document search is needed.
<table>
<thead>
<tr>
<th>Program Features</th>
<th>Demo</th>
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</table>

Access the program at **sen4aar.com**
Road Map for the Structural Assessment of Concrete Dams Suffering from AAR; Application to Seminoe Dam
Provide technical **background** and **procedure** for a State of the Art analysis of a dam suffering from AAR.

- **Static and Dynamic**
- **Deterministic and Probabilistic**
## Road Map ... Application to Seminoe Dam

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## Content

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<tr>
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<th>Probabilistic Based Earthquake Engineering for Dams</th>
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<tbody>
<tr>
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<td>Expansion curves</td>
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<td>2</td>
<td>Step by Step AAR Analysis</td>
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<tr>
<td>3</td>
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