

Oct 09, 2025

Systematic Literature Review Protocol: Strategies for Identifying Residual Expansion in Concrete Cores

DOI

<https://dx.doi.org/10.17504/protocols.io.3byl46dbogo5/v1>

Maria Eduarda Santana de Melo¹, Eudes de Arimátea Rocha¹, Fernando Artur Nogueira Silva²,
Emilia Kohlman Rabbani¹

¹University of Pernambuco (UPE); ²Catholic University of Pernambuco (UNICAP)



MARIA EDUARDA SANTANA DE MELO

Create & collaborate more with a free account

Edit and publish protocols, collaborate in communities, share insights through comments, and track progress with run records.

Create free account

OPEN  ACCESS



DOI: <https://dx.doi.org/10.17504/protocols.io.3byl46dbogo5/v1>

Protocol Citation: Maria Eduarda Santana de Melo, Eudes de Arimátea Rocha, Fernando Artur Nogueira Silva, Emilia Kohlman Rabbani 2025. Systematic Literature Review Protocol: Strategies for Identifying Residual Expansion in Concrete Cores.

protocols.io <https://dx.doi.org/10.17504/protocols.io.3byl46dbogo5/v1>

License: This is an open access protocol distributed under the terms of the **Creative Commons Attribution License**, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited

Protocol status: Working

We use this protocol and it's working

Created: October 08, 2025

Last Modified: October 09, 2025

Protocol Integer ID: 229365

Keywords: Concrete, Cementitious material, Concrete core, Concrete specimen, Concrete sample, Core testing, Extracted sample, Residual expansion, Residual strain, Swelling, Remaining expansion, Expansion test, residual expansion in concrete core, concrete deterioration, residual expansion assessment, monitoring of concrete deterioration, concrete core, identifying residual expansion, residual expansion, deleterious reactions such as the alkali, expansion value, systematic literature review protocol, aggregate reaction, alkali, systematic literature review

Abstract

This protocol presents the methodological framework for conducting a Systematic Literature Review (SLR) on experimental strategies used to identify residual expansion in concrete cores. The study aims to analyze and compare testing methods, experimental conditions, and cut-off criteria applied in residual expansion assessments, as well as to identify their reported limitations and complementary techniques. Searches will be performed in the ScienceDirect, Scopus, and Web of Science databases, considering studies written in English or French and available in full text. Only quantitative and experimental peer-reviewed studies will be included. Data extraction will encompass methodological details, test conditions, expansion values, and relevance to the understanding of deleterious reactions such as the Alkali–Aggregate Reaction (AAR). The expected outcome is to provide a comparative synthesis of the most effective experimental approaches and their applicability to the diagnosis and monitoring of concrete deterioration.

Guidelines

This protocol involves a Systematic Literature Review (SLR) and does not include any laboratory or field experiments involving human participants, animals, or hazardous materials. Therefore, no specific safety warnings apply.

All procedures follow ethical research practices for secondary data analysis, ensuring accurate citation, transparency, and reproducibility.

It is recommended that researchers document each stage of the review process (search, screening, and extraction) and keep digital backups of the databases and inclusion records to maintain methodological reliability.



Materials

The following digital tools and resources are required to conduct this Systematic Literature Review (SLR):

- **Computational resources:**

A computer with stable internet access and sufficient storage capacity for exporting and organizing bibliographic data.

- **Scientific databases:**

ScienceDirect

Scopus

Web of Science

- **Reference management software:**

Mendeley or *Zotero* (for organizing and citing retrieved studies)

- **Systematic review management software:**

Parsifal (<https://parsif.al>) — for screening, inclusion/exclusion, and data extraction workflow

- **Spreadsheet editor:**

Microsoft Excel or *Google Sheets* — for data organization and extraction form management

- **Document editor:**

Microsoft Word or equivalent — for drafting the protocol and review manuscript

- **Reporting guideline:**

PRISMA 2020 Statement — to ensure transparency and reproducibility of the review process

Safety warnings

- ! ■ This protocol involves only secondary data analysis; therefore, no physical, chemical, or biological risks are associated with its execution.
- Inaccurate recording of search results or inclusion criteria may lead to bias or loss of reproducibility.
- Researchers must document all modifications to search strings, selection criteria, or data extraction procedures to ensure transparency.
- Duplicate removal and screening steps should be performed carefully to avoid unintended exclusion of relevant studies.
- Ensure that all references are cited correctly to prevent plagiarism or ethical misconduct.

Ethics statement

This study is a Systematic Literature Review (SLR) based exclusively on previously published data.

It does not involve experiments with humans, animals, or the use of confidential or sensitive information.

Therefore, no approval from an ethics committee or Institutional Animal Care and Use Committee (IACUC) was required.

All data collection and reporting procedures follow ethical research standards, including transparency, reproducibility, and proper citation of original sources.

Before start

Before starting, ensure that all preliminary preparations for the Systematic Literature Review (SLR) are completed.

The following steps are recommended:

1. **Define the research question** according to the PICO framework (Population, Interest, Context).
2. **Confirm the inclusion and exclusion criteria** and prepare a spreadsheet to record all retrieved studies.
3. **Create accounts or verify institutional access** to the selected databases (*ScienceDirect*, *Scopus*, and *Web of Science*).
4. **Set up the reference management tools**, such as *Mendeley* or *Zotero*, to organize and cite the articles.
5. **Install the Parsifal software** (<https://parsif.al>) to manage the screening and selection process.
6. **Ensure internet stability and storage capacity** for exporting results and maintaining backup files.

Description

- 1 This Systematic Literature Review (SLR) aims to analyze and synthesize the existing literature on experimental techniques employed to identify residual expansion in concrete cores. The study seeks to map and compare the testing methods used, their application conditions, and the limitations reported.
The relevance of this SLR lies in the need to systematize the current knowledge on residual expansion identification tests, a key topic for the diagnosis and monitoring of structures affected by deleterious reactions such as the Alkali–Aggregate Reaction (AAR), which remains scarcely consolidated in the literature.

Objective

- 2 To identify, analyze, and compare the experimental strategies used to determine residual expansion in concrete cores.

Main Research Question

- 3 The research question(s) of this Systematic Literature Review (SLR) were derived from the elements defined in the PICo framework, as described below.
 - 3.1 PICo Criteria:
 - **Population:** Concrete
 - **Interest:** Techniques and tests for identification
 - **Context:** Residual expansion
 - 3.2 Research Questions:
 - **P1:** What is the state of the art regarding experimental strategies used to identify residual expansion in concrete cores?
 - **P2:** What testing conditions (such as temperature, humidity, duration, and storage medium) are adopted in the studies?
 - **P3:** What limitations and contributions do the authors report concerning the applicability of the methods?

Keywords and Synonyms

- 4 The search terms used in this Systematic Literature Review (SLR) were defined according to the PICo criteria, including main terms, synonyms, and their Portuguese equivalents, as follows:

- **Population**

Main terms: *Concrete*

Synonyms: *Cementitious material*

- **Interest**

Main terms: *Concrete core, concrete specimen, concrete sample*

Synonyms: *Core testing, extracted sample*

- **Context**

Main terms: *Residual expansion, residual strain, swelling*

Synonyms: *Remaining expansion, expansion test*

Source Selection Criteria (Databases)

5 Adopted Criteria

The databases *ScienceDirect*, *Scopus*, and *Web of Science* were selected because they cover high-impact, peer-reviewed scientific publications in the fields of Civil Engineering and Materials Science. These databases provide access to recent experimental and methodological studies relevant to the topic of this review.

6 Selected Databases

The following databases will be used in this Systematic Literature Review (SLR):

- **ScienceDirect** — <http://www.sciencedirect.com>
- **Scopus** — <https://www.scopus.com/home.uri>
- **Web of Science** — <https://www.webofscience.com/wos/>

7 Limitations

Studies written in English or French with full-text availability will be included.

The following will be excluded:

- Duplicated publications
- Review papers
- Technical reports
- Communications without experimental content

8 Search Strings

Generic search string:

(Concrete) AND ("Residual expansion" OR "Residual strain" OR "Swelling")
AND ("Concrete core" OR "Concrete specimen" OR "Concrete sample")
AND ("Test method" OR "Experimental procedure")

Adapted search strings for each database:

ScienceDirect

```
Concrete AND ("Residual expansion" OR "Residual strain" OR  
Swelling)  
AND ("Concrete core" OR "Concrete specimen" OR "Concrete sample")  
AND ("Test method" OR "Experimental procedure")
```

Scopus

```
TITLE-ABS-KEY (Concrete AND ("Residual expansion" OR "Residual  
strain" OR Swelling)  
AND ("Concrete core" OR "Concrete specimen")  
AND ("Test method" OR "Experimental procedure"))
```

Web of Science

```
TS=(Concrete AND ("Residual expansion" OR "Residual strain" OR  
Swelling)  
AND ("Concrete core" OR "Concrete specimen")  
AND ("Test method" OR "Experimental procedure"))
```

9 Search Method

The search will be carried out systematically in the *ScienceDirect*, *Scopus*, and *Web of Science* databases, using the adapted strings and Boolean operators.

Only peer-reviewed articles written in English or French will be considered.

The retrieved results will be exported and organized using the **Parsifal** software, where duplicates will be removed, followed by screening based on **title, abstract, and keywords**, according to the predefined inclusion and exclusion criteria.

Study Selection Criteria (Inclusion and Exclusion)

10 Definition of Study Type

The following types of studies will be included in this Systematic Literature Review (SLR), focusing on the direct application of experimental tests for identifying residual expansion:

- **Quantitative studies**
- **Experimental studies**

11 Inclusion and Exclusion Criteria

Inclusion Criteria (IC):

- **IC1:** Articles addressing tests and experimental procedures for identifying residual expansion in concrete.
- **IC2:** Articles presenting experimental methodologies applied to concrete cores or specimens.
- **IC3:** Articles published in peer-reviewed scientific journals.

Exclusion Criteria (EC):

- **EC1:** Duplicate articles.
- **EC2:** Articles that do not address residual expansion.
- **EC3:** Articles without full-text access.
- **EC4:** Articles lacking experimental content.
- **EC5:** Secondary studies (reviews).

12 Quality Criteria

The following quality assessment criteria will be applied to evaluate the selected studies:

- **QC1:** Clarity in the description of the experimental methodology.
- **QC2:** Indication of testing conditions (temperature, medium, and duration).
- **QC3:** Specification of the number of samples and preparation procedures for concrete cores.
- **QC4:** Presentation of quantitative expansion results.
- **QC5:** Explicit statement of study limitations.

Quality Assessment Form

- 13 The quality assessment form aims to analyze the **methodological robustness** of the studies included in this Systematic Literature Review (SLR), verifying whether they demonstrate **clarity, reproducibility, and reliability** in the description and application of experimental tests.

14 Assessment Criteria and Scoring

Each study will be evaluated according to the following criteria, using a **0–2 scoring scale**:

- **QC1:** Does the study clearly describe the experimental method used to identify residual expansion?
- **QC2:** Are the testing conditions (temperature, humidity, duration, and storage medium) reported in sufficient detail?
- **QC3:** Is the number of samples and the preparation procedure for the concrete cores specified?
- **QC4:** Does the study present quantitative expansion results (values, curves, or percentages)?
- **QC5:** Does the study discuss the limitations and uncertainties of the applied method?

15 Scoring Scale

- **0 = Does not meet the criterion**
- **1 = Partially meets the criterion**
- **2 = Fully meets the criterion**

Maximum score: 10 points

Inclusion threshold: ≥ 6 points

Risk of Bias Assessment Form

- 16 The risk of bias assessment form aims to identify factors that may compromise the **reliability and validity** of the experimental results.

The evaluation will be **qualitative**, using the following levels of risk: **Low / Medium / High**.

17 Types of Bias and Evaluation Questions

- **Selection Bias:**
Was the method used to select the concrete specimens described and justified?
- **Performance Bias:**
Were the testing conditions (temperature, humidity, duration, and storage medium) reported in sufficient detail?
- **Detection Bias:**
Was the method used to measure expansion validated or compared with a technical standard?
- **Reporting Bias:**
Were all results presented, with no omission of relevant data?

- **Interpretation Bias:**

Are the conclusions consistent with the results obtained?

18 Risk Classification

Each bias will be qualitatively classified as:

- **Low risk**
- **Medium risk**
- **High risk**

Eligibility and Data Extraction Form

- 19 This form aims to organize and structure the information extracted from the selected studies, facilitating comparison among experimental techniques and results.

20 Data Fields and Descriptions

- **ID:** Identification number of the article in the spreadsheet (order).
- **Title:** Full title of the study.
- **Authors/Year:** Names of the authors and year of publication.
- **Journal:** Name of the scientific journal in which the study was published.
- **Country:** Country of the main author's affiliated institution.
- **Residual Expansion Identification Technique:** Test method used to identify residual expansion.
- **Testing Conditions:** Temperature, humidity, duration, and storage medium adopted in the experiment.
- **Cut-off Criterion:** Threshold value adopted to define significant residual expansion.
- **Complementary Methods:** Additional or auxiliary tests used in the study.
- **Main Results:** Average expansion values and main conclusions reported.
- **Limitations:** Methodological or experimental limitations explicitly stated by the authors.
- **Contributions to the Review:** Relevance of the study to the advancement of knowledge on residual expansion in concrete.

Summary of Expected Results

- 21 It is expected that this review will identify the main experimental techniques used to measure residual expansion, along with their testing conditions, adopted cut-off criteria, and complementary methods.

This synthesis will enable a comparative analysis of the most effective experimental strategies and their limitations regarding applicability in concrete pathology studies.

Protocol references

KITCHENHAM, B. **Procedures for performing systematic reviews**. Keele, UK, Keele University, v. 33, n. 2004, p. 1-26, 2004.

KITCHENHAM, B. **Guidelines for performing systematic literature reviews in software engineering**. Technical report, Ver. 2.3 EBSE Technical Report. EBSE, 2007.

TRAVASSOS, G.; BIOLOCHINI, J. Revisões sistemáticas aplicadas a engenharia de software. **XXI SBES-Brazilian Symposium on Software Engineering**, 2007.

Acknowledgements

The authors would like to express their gratitude to the **University of Pernambuco (UPE)** for providing institutional support and resources throughout the development of this study.

Special thanks are also extended to **MSc. Alisson** for his valuable guidance and assistance during the preparation of this protocol.