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## Plan Overview

*A Data Management Plan created using DMPOnline.be*

**Title:** Study of combined corrosion processes in reinforced concrete under natural degradation conditions with 4D X-ray Computed Tomography

**Creator:** Charlotte Van Steen

**Principal Investigator:** Charlotte Van Steen

**Affiliation:** KU Leuven (KUL)

**Funder:** Fonds voor Wetenschappelijk Onderzoek - Research Foundation Flanders (FWO)

**Template:** FWO DMP (Flemish Standard DMP)

**Principal Investigator:** Charlotte Van Steen

### Project abstract:

Corrosion of steel in reinforced concrete (RC) is one of the main challenges in structural engineering. The impact of single degradation mechanisms of either carbonation- or chloride-induced corrosion is well-studied and service life prediction of RC structures is based on these single actions. However, this is not always realistic for on-site situations as both processes typically occur combined over the lifetime of the structure and may reinforce each other. Moreover, an important challenge lies in making long-term predictions for field performance based on short-term laboratory testing. Current applied accelerated tests are not representative to mimic natural conditions. This project aims to fundamentally understand natural combined corrosion mechanisms in RC structures by using advanced non-destructive techniques. Corrosion-induced damage due to single and combined actions is investigated. The effect of corrosion acceleration is studied. The findings in the laboratory are compared with samples extracted from case studies to identify differences between laboratory-made and on-site samples. The analyses are performed with advanced non-destructive techniques such as X-ray Computed Tomography (XCT) and the Acoustic Emission (AE) technique. Both techniques allow to study the time and space distribution of the corrosion process (4D-XCT and 4D-AE). The project will strengthen the knowledge on concrete degradation in view of future on-site assessment and service life modelling.

**ID:** 211961

**Start date:** 01-10-2024

**End date:** 30-09-2027

**Last modified:** 06-02-2025

**Study of combined corrosion processes in reinforced concrete under natural degradation conditions  
with 4D X-ray Computed Tomography**

**DPIA**

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DPIA

Have you performed a DPIA for the personal data processing activities for this project?

- Not applicable

# Study of combined corrosion processes in reinforced concrete under natural degradation conditions with 4D X-ray Computed Tomography

## Application DMP

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### Questionnaire

**Describe the datatypes (surveys, sequences, manuscripts, objects ... ) the research will collect and/or generate and /or (re)use. (use up to 700 characters)**

Within the project, data are generated through experimental tests. The obtained datatypes will contain images from X-ray Computed Tomography (XCT) scans (.jpg or .tif) and Acoustic Emission (AE) monitoring data sets (Vallen software (.pridb and .tradb) and Matlab (.mat)), summary of test data with other techniques than XCT and AE (phenolphthalein tests to determine the carbonation front, chloride profiles, crack width measurements,...) in Excel (.xls), and pictures of the samples and setups (.png or .jpg). Besides, post-processing algorithms will be generated in Matlab (.m).

**Specify in which way the following provisions are in place in order to preserve the data during and at least 5 years after the end of the research? Motivate your answer. (use up to 700 characters)**

1. Responsible person: C. Van Steen (during the project), prof. E. Verstrynge (after the project)
2. - During the project: data are stored according to the format defined in the data management plan.  
A backup of the data is made on a daily basis to the general backup servers provided by KU Leuven ICTS or immediately when important tests have been performed.  
- After the project: when data are no longer needed to be accessed on a daily basis, they are stored in the KU Leuven Large Volume Storage facilities for at least 5 years.

**What's the reason why you wish to deviate from the principle of preservation of data and of the minimum preservation term of 5 years? (max. 700 characters)**

NA

**Are there issues concerning research data indicated in the ethics questionnaire of this application form? Which specific security measures do those data require? (use up to 700 characters)**

NA

**Which other issues related to the data management are relevant to mention? (use up to 700 characters)**

NA

**Study of combined corrosion processes in reinforced concrete under natural degradation conditions  
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**GDPR**

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GDPR

Have you registered personal data processing activities for this project?

- No

# Study of combined corrosion processes in reinforced concrete under natural degradation conditions with 4D X-ray Computed Tomography

## FWO DMP (Flemish Standard DMP)

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### 1. Research Data Summary

List and describe all datasets or research materials that you plan to generate/collect or reuse during your research project. For each dataset or data type (observational, experimental etc.), provide a short name & description (sufficient for yourself to know what data it is about), indicate whether the data are newly generated/collected or reused, digital or physical, also indicate the type of the data (the kind of content), its technical format (file extension), and an estimate of the upper limit of the volume of the data.

				Only for digital data	Only for digital data	Only for digital data	Only for physical data
Dataset Name	Description	New or reused	Digital or Physical	Digital Data Type	Digital Data format	Digital data volume (MB/GB/TB)	Physical volume
<b>WP2: On-site samples</b>							
On-site samples WP2	Reinforced concrete samples taken as cores from existing reinforced concrete structures	New	Physical				12 cores, diameter and height to be decided
Raw XCT scans WP2	Raw scans obtained with X-ray computed tomography of the cores	New	Digital	Experimental, images	.jpg or .tiff	< 1 TB	
Processed XCT scans WP2	Processed scans obtained with X-ray computed tomography, processed means after filtering and image enhancement	New	Digital	Experimental, images	.jpg	< 1 TB	
Observations WP2	Additional observations and measurements made during the tests of WP2, this includes crack measurements, results from on-site standard tests (carbonation depth and chloride profiles) and other related observations/measurements	New	Digital	Observational/experimental	.xlsx	< 100 MB	
Pictures WP2	Pictures taken from structures and small-scale samples	New	Digital	Experimental, pictures	.jpg	< 1 GB	
<b>WP3: Corrosion monitoring of laboratory samples</b>							

Samples WP3	Reinforced concrete cylinders for accelerated and natural corrosion tests	New	Physical				16 small-scale reinforced concrete samples (cylinders diameter 32 mm, height 50 mm) for accelerated tests 12 small-scale reinforced concrete samples (cylinders diameter 32 mm, height 50 mm) for natural corrosion tests
Standard tests WP3	Standard concrete samples for material characterization	New	Physical				Min. 3 concrete cubes (150x150x150 mm <sup>3</sup> ) per concrete batch Min. 3 concrete prisms (150x150x600 mm <sup>3</sup> ) per concrete batch Min. 4 concrete cylinders for carbonation and chloride tests
Raw XCT scans WP3	Raw scans obtained with X-ray computed tomography of accelerated and natural corrosion tests	New	Digital	Experimental, images	.jpg or .tiff	< 1 TB	
Processed XCT scans WP3	Processed scans obtained with X-ray computed tomography, processed means after filtering and image enhancement	New	Digital	Experimental, images	.jpg	< 1 TB	
Raw AE data WP3	Raw acoustic emission data in original software	New	Digital	Experimental	.pridb and .tradb	< 100 GB	
Processed AE data WP3	Processed acoustic emission data in Matlab, processed means after filtering	New	Digital	Experimental	.mat	< 100 GB	
Pictures WP3	Pictures taken from small-scale samples during testing	New	Digital	Experimental, pictures	.jpg	< 1 GB	
<b>WP4: Analysis and comparison of the data sets</b>							

Algorithms WP4	Various algorithms for data processing in Matlab	New	Digital	Software	.m	< 100 MB	
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If you reuse existing data, please specify the source, preferably by using a persistent identifier (e.g. DOI, Handle, URL etc.) per dataset or data type:

NA

Are there any ethical issues concerning the creation and/or use of the data (e.g. experiments on humans or animals, dual use)? Describe these issues in the comment section. Please refer to specific datasets or data types when appropriate.

- No

Will you process personal data? If so, briefly describe the kind of personal data you will use in the comment section. Please refer to specific datasets or data types when appropriate.

- No

Does your work have potential for commercial valorization (e.g. tech transfer, for example spin-offs, commercial exploitation, ...)? If so, please comment per dataset or data type where appropriate.

- No

Do existing 3rd party agreements restrict exploitation or dissemination of the data you (re)use (e.g. Material/Data transfer agreements/ research collaboration agreements)? If so, please explain in the comment section to what data they relate and what restrictions are in place.

- No

Are there any other legal issues, such as intellectual property rights and ownership, to be managed related to the data you (re)use? If so, please explain in the comment section to what data they relate and which restrictions will be asserted.

- No

## 2. Documentation and Metadata

Clearly describe what approach will be followed to capture the accompanying information necessary to keep data understandable and usable, for yourself and others, now and in the future (e.g., in terms of documentation levels and types required, procedures used, Electronic Lab Notebooks, README.txt files, Codebook.tsv etc. where this information is recorded).

For experiments on physical samples, the measurement setup, the data acquisition parameters, the data processing steps, and the file structures will be described in a detailed measurement reports. These reports contain all details that are required to repeat

the experiment (if this would be required), process and interpret the data.

A ReadMe file describing the organization and the content of the MATLAB scripts is provided. Every file is clearly documented in the code by means of in-line comments. The results of the processing are described in a separate report and in publications.

**Will a metadata standard be used to make it easier to find and reuse the data? If so, please specify (where appropriate per dataset or data type) which metadata standard will be used. If not, please specify (where appropriate per dataset or data type) which metadata will be created to make the data easier to find and reuse.**

- No

### 3. Data storage & back-up during the research project

**Where will the data be stored?**

On the personal network drive (I-drive, 100 GB), OneDrive (KU Leuven, 250 GB), and Large Volume Storage (/TB).

**How will the data be backed up?**

By a standard back-up provided by KU Leuven ICTS for my storage solution and by personal back-ups I make. The data will also be backup on external hard drives.

**Is there currently sufficient storage & backup capacity during the project? If yes, specify concisely. If no or insufficient storage or backup capacities are available, then explain how this will be taken care of.**

- Yes

KU Leuven data storage can easily being extended depending on the size of the data sets.

**How will you ensure that the data are securely stored and not accessed or modified by unauthorized persons?**

KU Leuven has decent/protected backup facilities and server space.

The collected data does not contain sensitive or personal information. Therefore, no specific security measures are taken.

**What are the expected costs for data storage and backup during the research project? How will these costs be covered?**

The total expected cost for data storage and backup during the project equals +/- 456 EUR.

Two external hard drives with a capacity of 4 TB each will be bought, with a cost of +/- 150 EUR each, VAT incl., corresponding to a total cost of 300 EUR.

The use of KU Leuven OneDrive for Business is free of charge.

The cost for the 'Desktop File Storage' of KU Leuven equals 519 EUR/TB/year or +/- 156 EUR in total.

The costs for data storage and backup are covered by the allocated project budget.

### 4. Data preservation after the end of the research project



**Which data will be retained for at least five years (or longer, in agreement with other retention policies that are applicable) after the end of the project? In case some data cannot be preserved, clearly state the reasons for this (e.g. legal or contractual restrictions, storage/budget issues, institutional policies...).**

All data will be preserved for 10 years according to KU Leuven RDM policy

**Where will these data be archived (stored and curated for the long-term)?**

Large Volume Storage (longterm for large volumes) of KU Leuven

**What are the expected costs for data preservation during the expected retention period? How will these costs be covered?**

The cost for 'Large Volume Archive Storage' of KU Leuven ICTS is 113.84 EUR/TB/year, corresponding to an expected total cost of 569.20 EUR.

The cost for data preservation is covered by the division. The division has allocated budgets to cover the costs.

## **5. Data sharing and reuse**

**Will the data (or part of the data) be made available for reuse after/during the project? In the comment section please explain per dataset or data type which data will be made available.**

- Yes, in an Open Access repository
- Yes, in a restricted access repository (after approval, institutional access only, ...)

XCT scans and results from standard testing will be made available in an Open Access repository to allow other researcher to develop various models.

AE data and developed processing algorithms will be made available in restricted access repository to keep an eye on the distribution of the data. This data may be highly valuable for other research projects and follow-up research within the research division.

**If access is restricted, please specify who will be able to access the data and under what conditions.**

Members of the research groups of E. Verstrynge.

**Are there any factors that restrict or prevent the sharing of (some of) the data (e.g. as defined in an agreement with a 3rd party, legal restrictions)? Please explain in the comment section per dataset or data type where appropriate.**

- No

**Where will the data be made available? If already known, please provide a repository per dataset or data type.**

If an open access repository is set up, it may likely be RDR. Others are possible and will be considered.

**When will the data be made available?**

After publication of the research results.

**Which data usage licenses are you going to provide? If none, please explain why.**

This will probably be CC-BY 4.0.

**Do you intend to add a PID/DOI/accession number to your dataset(s)? If already available, you have the option to provide it in the comment section.**

- Yes

If an open access repository is set up, a DOI will be linked.

**What are the expected costs for data sharing? How will these costs be covered?**

Deposition of smaller datasets in data repositories is usually covered by the repository. For sharing physical data, the cost is typically paid by the researcher requesting the materials.

## **6. Responsibilities**

**Who will manage data documentation and metadata during the research project?**

The PI, C. Van Steen.

**Who will manage data storage and backup during the research project?**

The PI, C. Van Steen.

**Who will manage data preservation and sharing?**

The PI, C. Van Steen, and the supervisor, prof. E. Verstrynge.

**Who will update and implement this DMP?**

The PI, C. Van Steen.