Parallelsessie KPNK-symposium:

Voorspelling resterende levensduur betonconstructies in mariene omgevingen

Remaining service life prediction of concrete structures in marine environments

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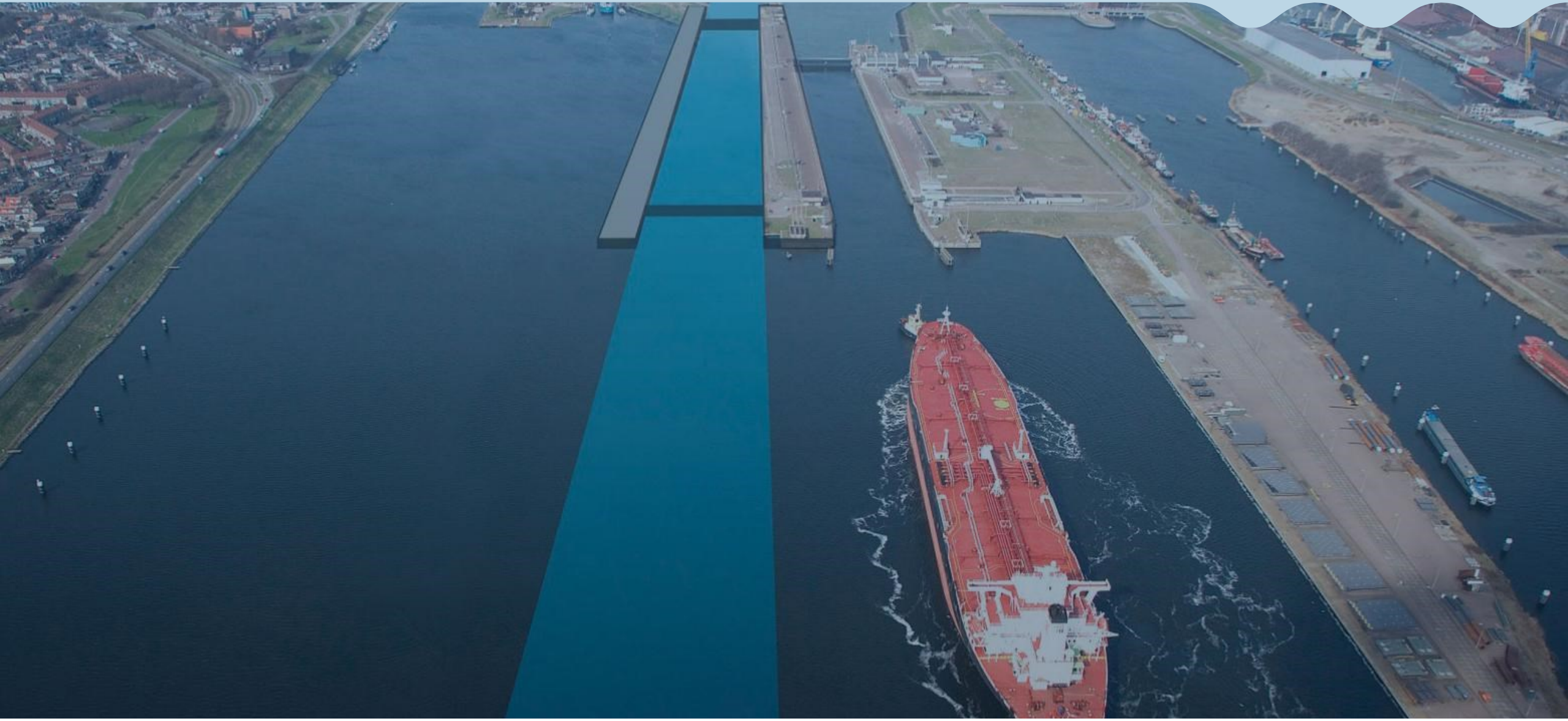


Agenda

- Introduction
- Challenge
- Goal
- Modeling approach
- Application
- Results & insights
- Conclusions & next steps

Introduction

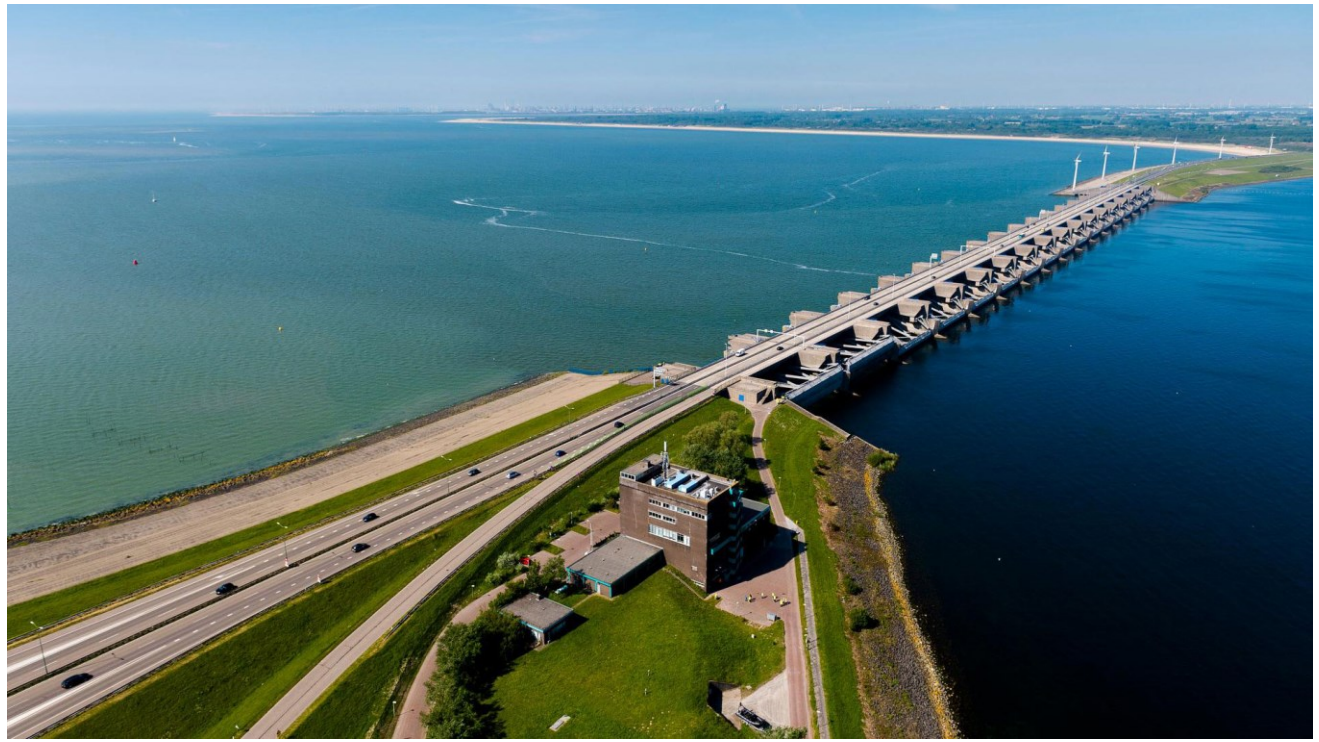
- Concrete as a construction material

Introduction

- North sea flood *(Waternoodsramp)*

Introduction

- Delta Works



Introduction

- Great societal and economical importance

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Introduction

- Durability issues
- Corrosion of steel

conservation layers of the segment sliders of the Haringvlietsluizen

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Challenge

- Predict the remaining service life of concrete structures in marine environments

Why is this important?

- Technical lifespan ~75-100 years
- Smarter Asset management: Informed decisions to extend service life
- Inspection data: To refine predictions
- Efficient planning: Improve time, and budget of large-scale maintenance projects

Goal

- Combine structural reliability theory with chloride-induced concrete degradation models to estimate the remaining service life of concrete structures in marine environments
- Develop a framework to support data driven maintenance strategies
- Integrate inspection results to update predictions → Informed asset management

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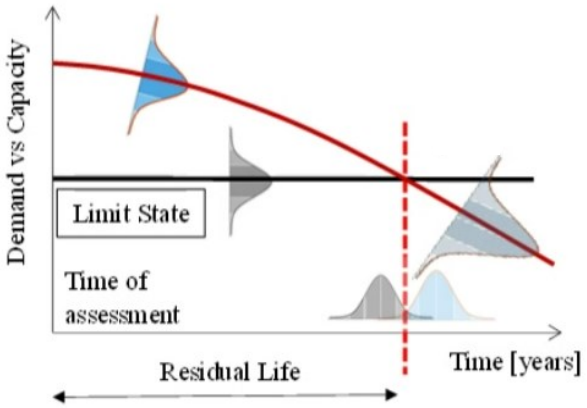
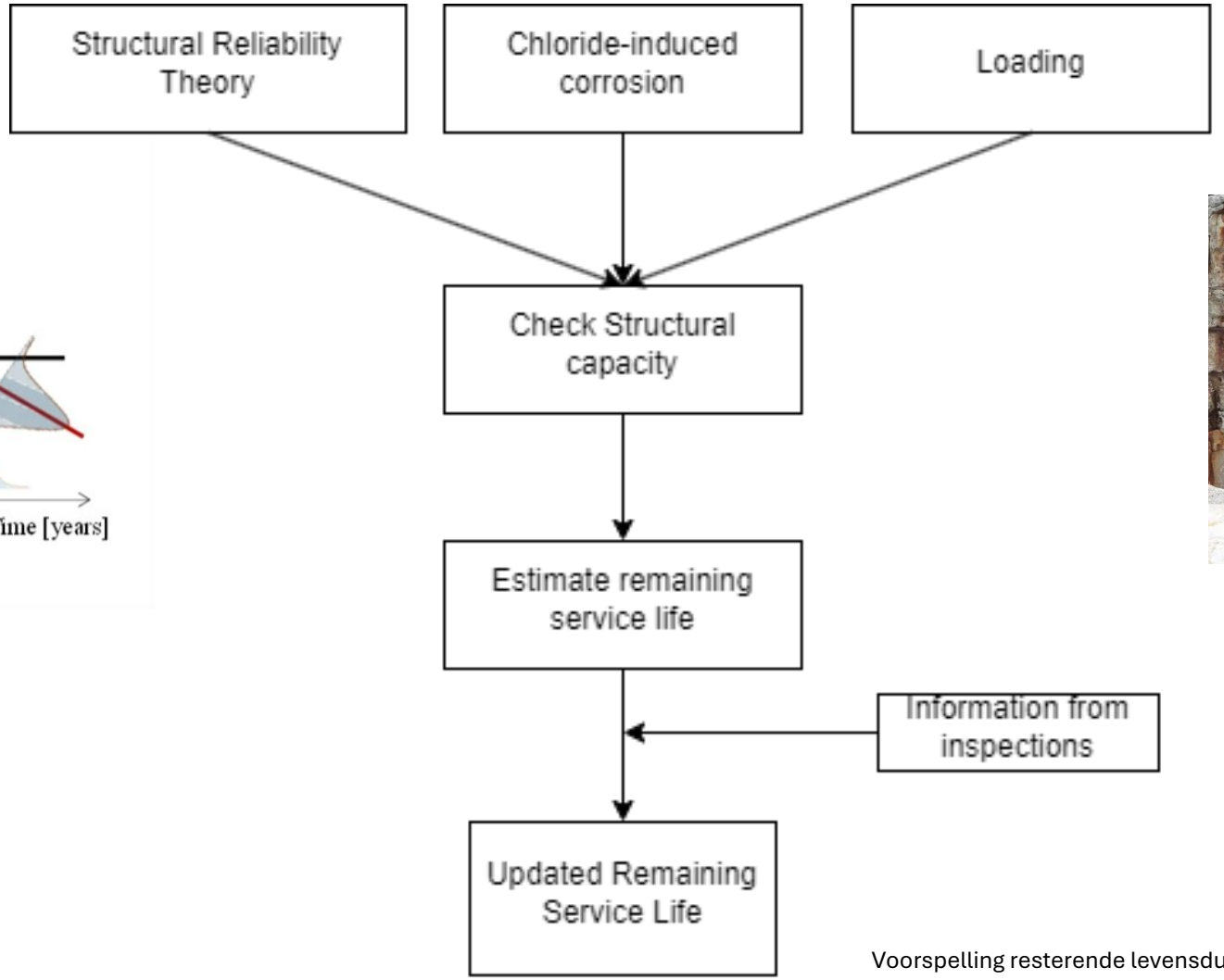
Steps taken: Modeling Approach





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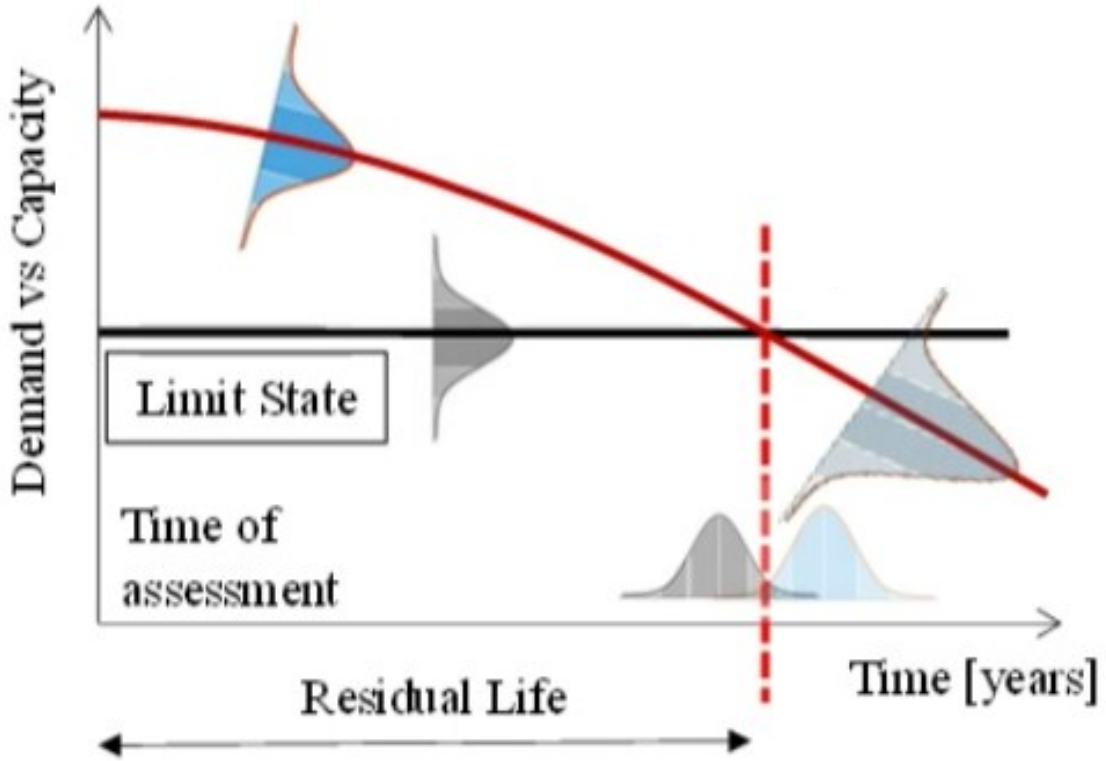
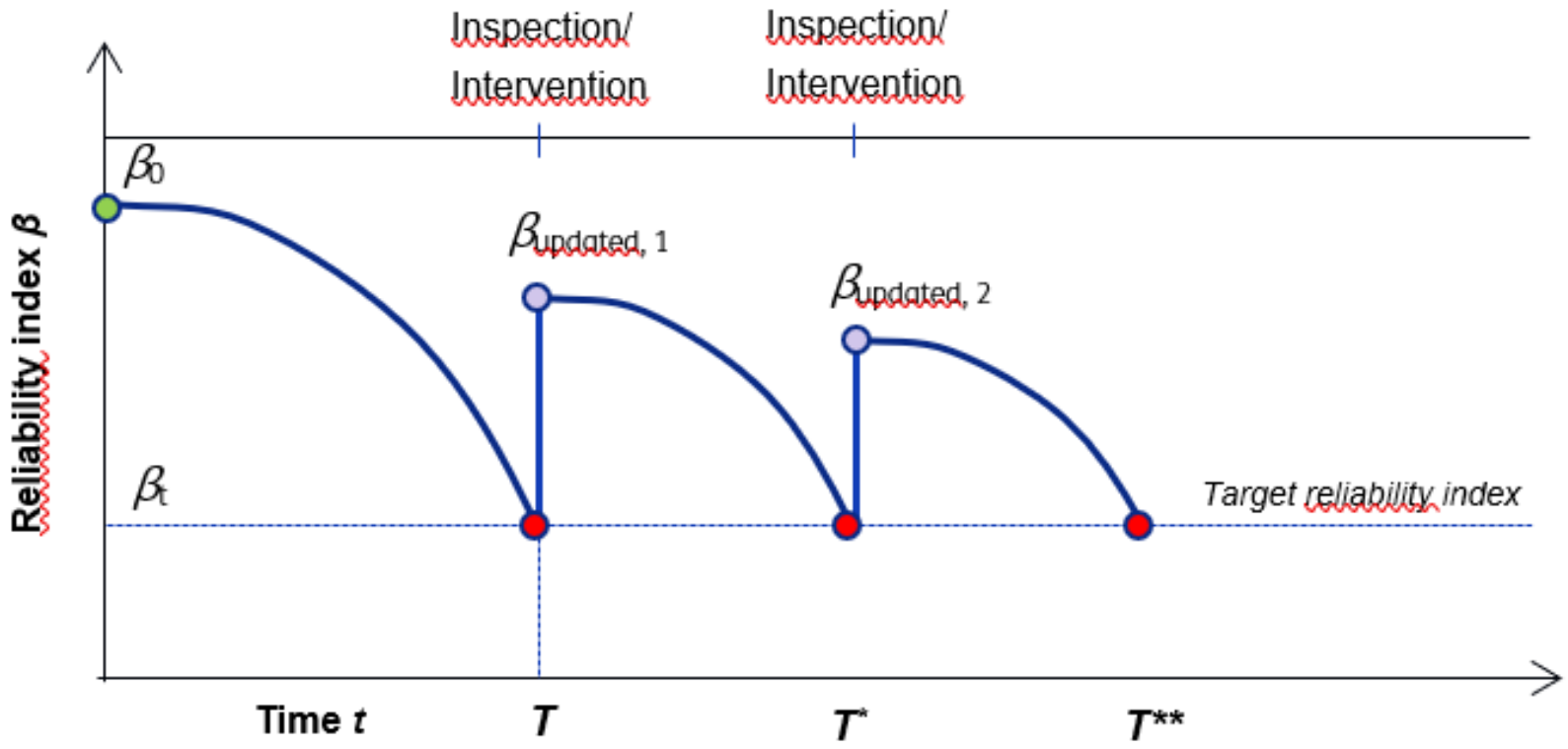
Structural reliability



Structural reliability

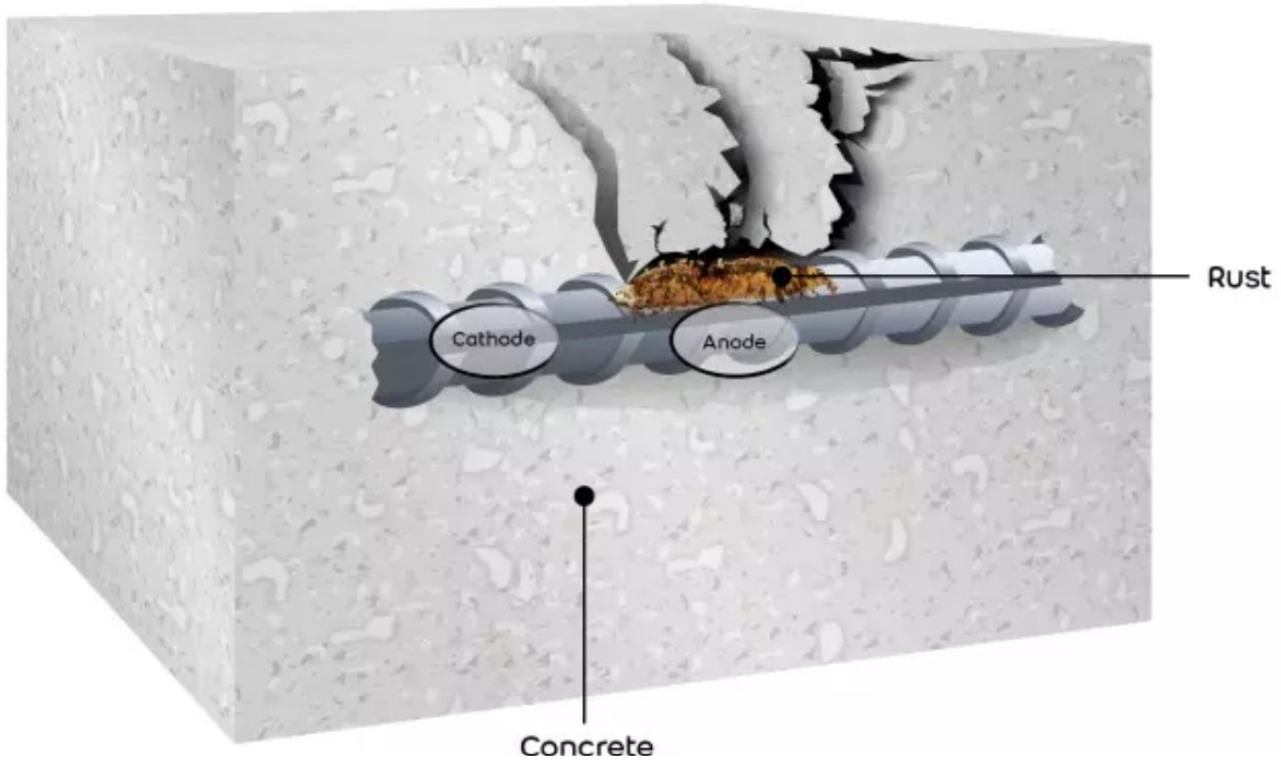


Updating reliability and lifetime extension through inspections. T* and T** correspond to the updated service lifetime

Chloride-induced corrosion

- Two phases:
  - Initiation phase
  - Propagation phase

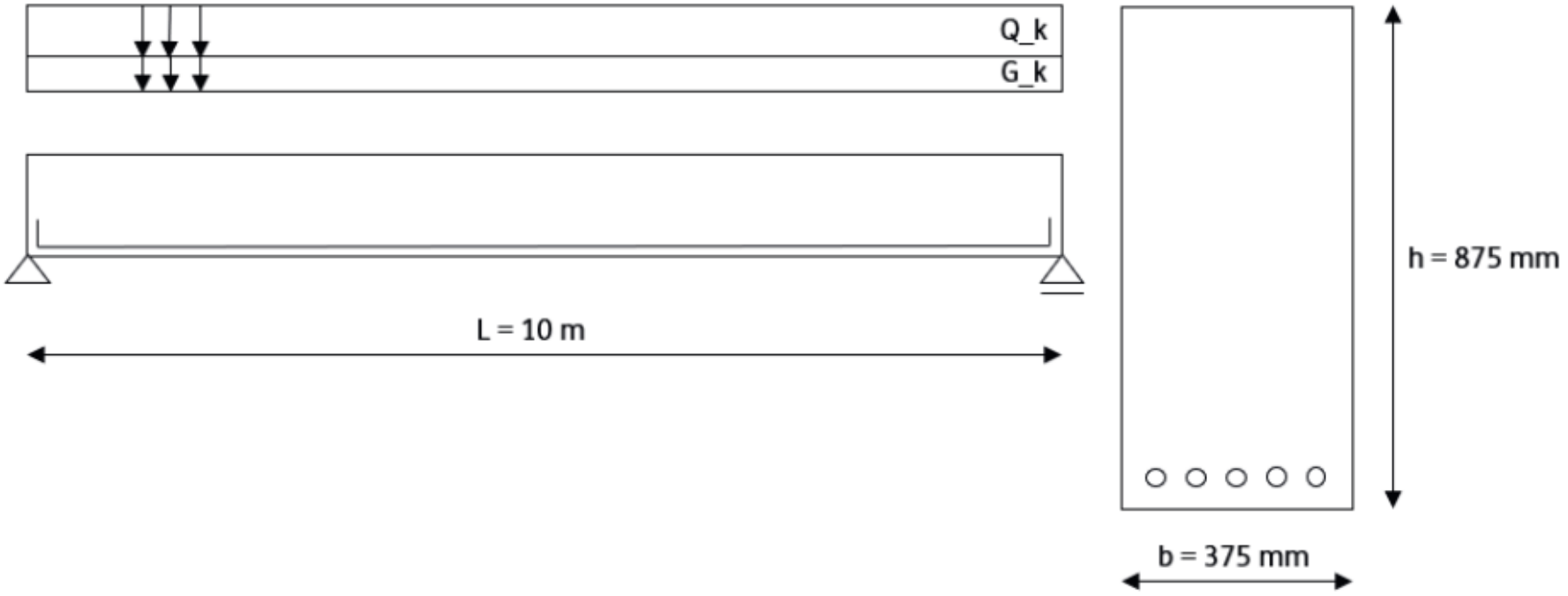
- DuMaCon/ DuraCrete models



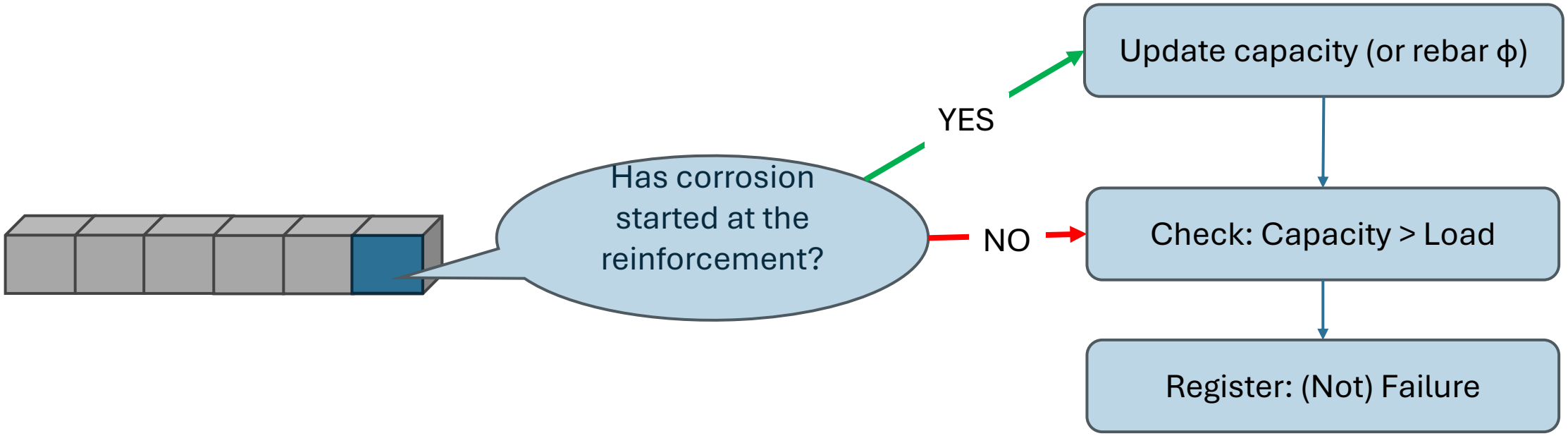
Application: Academic Example

- Reinforced concrete beam.

- Failure modes: Bending and shear
    - Concrete cover $(\mathbf{45})$ mm
    - Self-weight (G_k)
    - Variable load (Q_k)

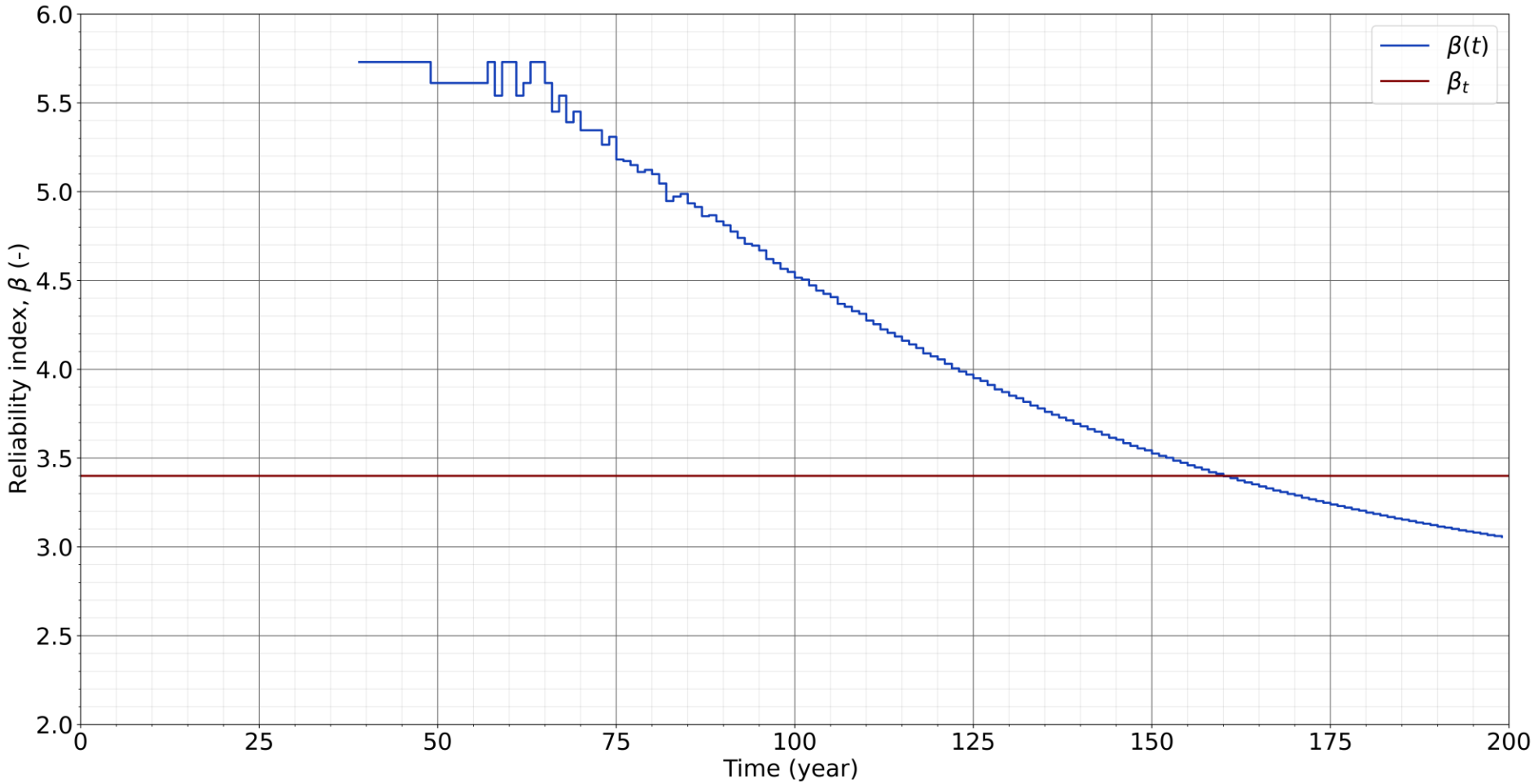


Application: Academic Example



t~200 years

Results



Note: for this case study only!

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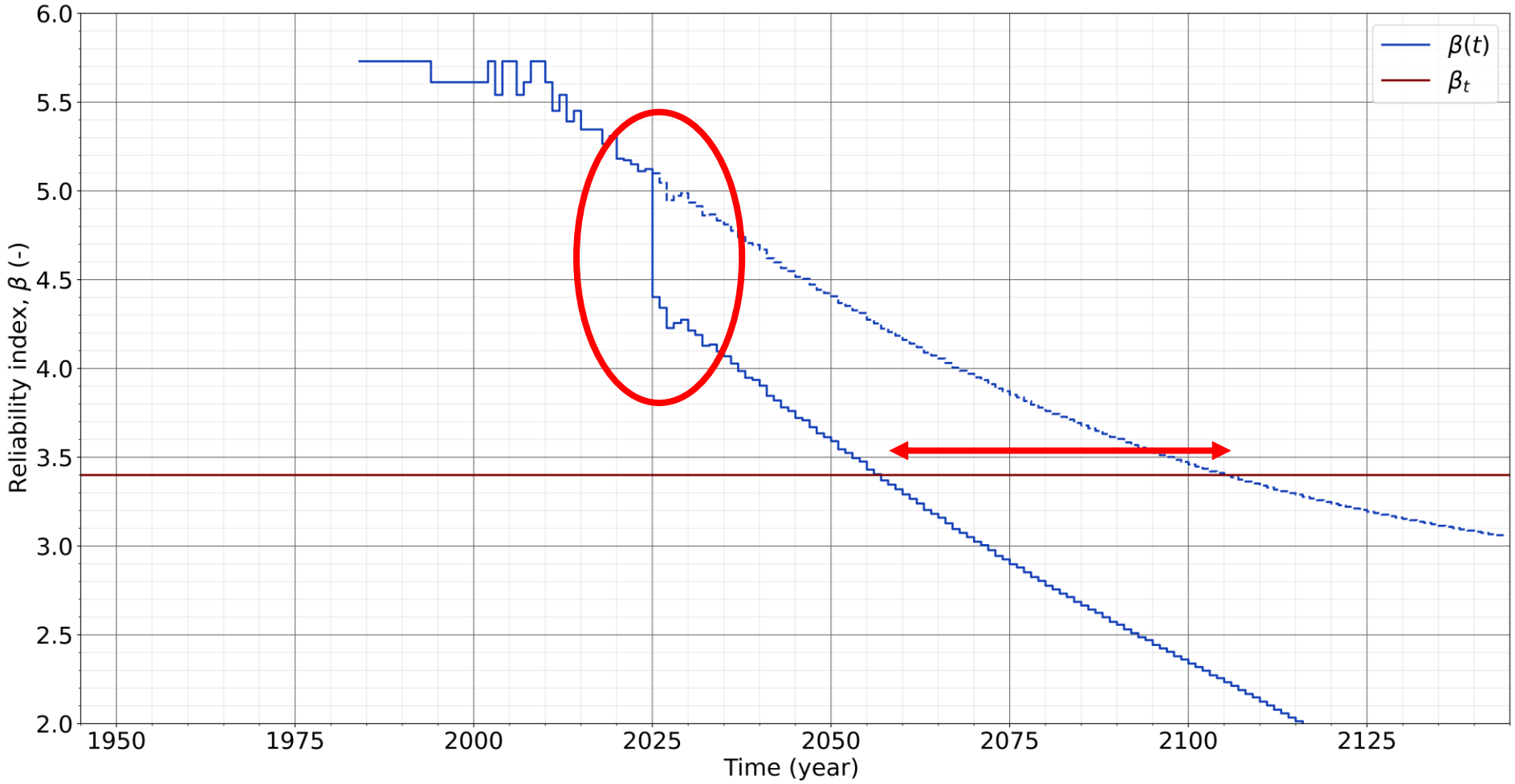
Inspections to update the predicted remaining service life

Example

You own an asset built in 1945 with a design life time of 100 years. In 2025 you want to investigate the structural state of this structure. After inspecting the rebar you conclude that the reinforcement is corroding.

How does this information change the predicted remaining service life?

Inspections to update the predicted remaining service life



Conclusions

- **More grip on the structural state of assets:**
  - The framework allows asset managers predict the remaining service life of structures under chloride-induced corrosion.
- **Data-driven decisions:**
  - Use data to improve maintenance strategies.

Next steps

- **Enhance model:**
  - Integrating other inspection results.
  - Increase the scope of the framework.
- What do you need to use it right now? What is needed for the future?

Het kennisprogramma loopt door !

Interesse of meedoen?

Bezoek nattekunstwerkenvandetoekomst.nl/meedoen

Rapporten:

https://www.nattekunstwerkenvandetoekomst.nl/kennisbank/

Deltares

MARIN

Rijkswaterstaat
Ministerie van Infrastructuur en Waterstaat

TNO innovation for life

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