Development and Validation of

DS/INF 671: Guidelines for Reusability Assessment of Structural Concrete Elements

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Background

- Construction and Demolition **~35 %** of the waste produced worldwide
- Concrete production **~8-9 %** global anthropogenic CO_2 emission
- Reusing structural elements can:
  - Decreases CO_2 emission
  - Decreases waste,
  - Reduces consumption of natural resources

Nawaz, A., Chen, J., & Su, X. (2023). Exploring the trends in construction and demolition waste (C&DW) research: A scientometric analysis approach. Sust. En. Tech. and Asses., 55, 102953.
Monteiro, P. J., Miller, S. A., & Horvath, A. (2017). Towards sustainable concrete. Nature materials, 16(7), 698-699.

Approach

– Barrier/Problem: Documenting properties of structural elements for reuse,

– Solution: NDT-based reusability assessment

  • Combining multiple NDT methods

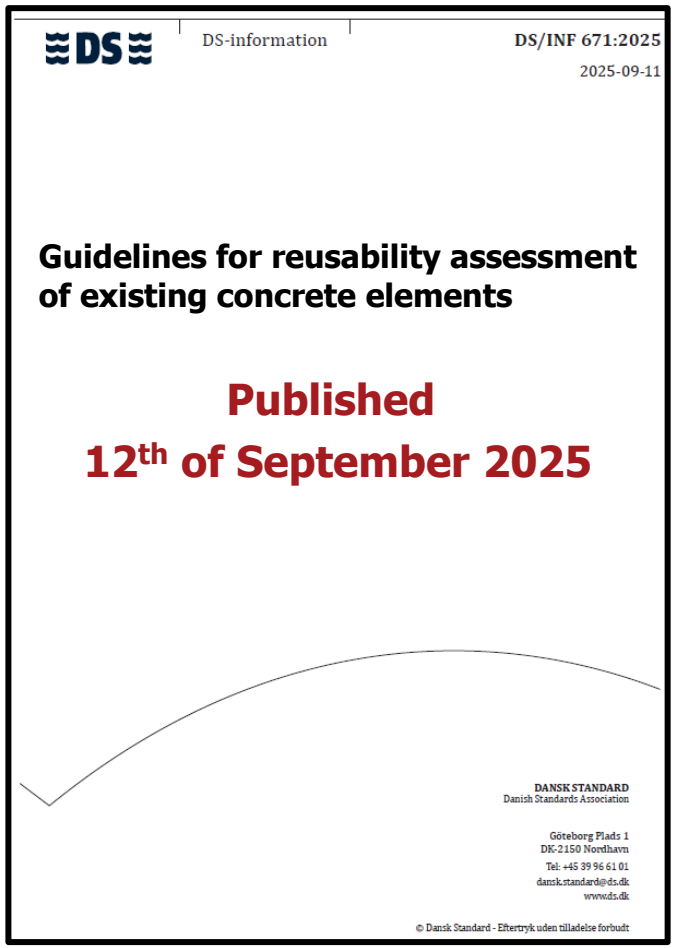
– Method: Developing a standardized assessment procedure

  • for precast solid structural concrete elements serviced in (X0 or XC1)(Solvable maximum potential)

– Constraint: For scalable reuse, practitioners/engineers could perform practically

  • Well standardized/commercialized methods,
  • Simple/standardized applications

DS/INF 671: Guidelines for reusability assessment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Guidelines for reusability assessment of existing concrete elements

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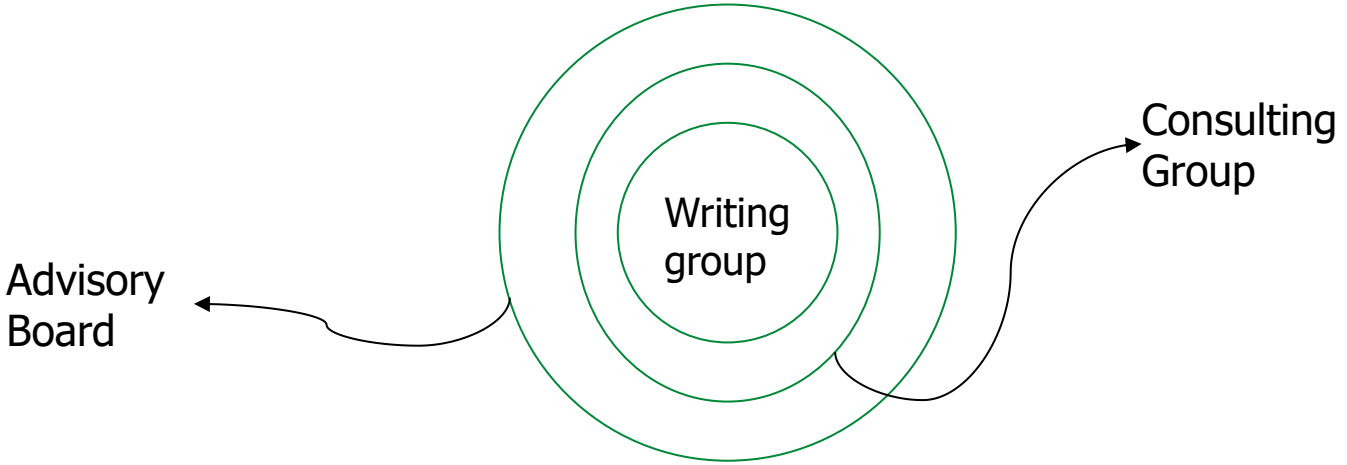
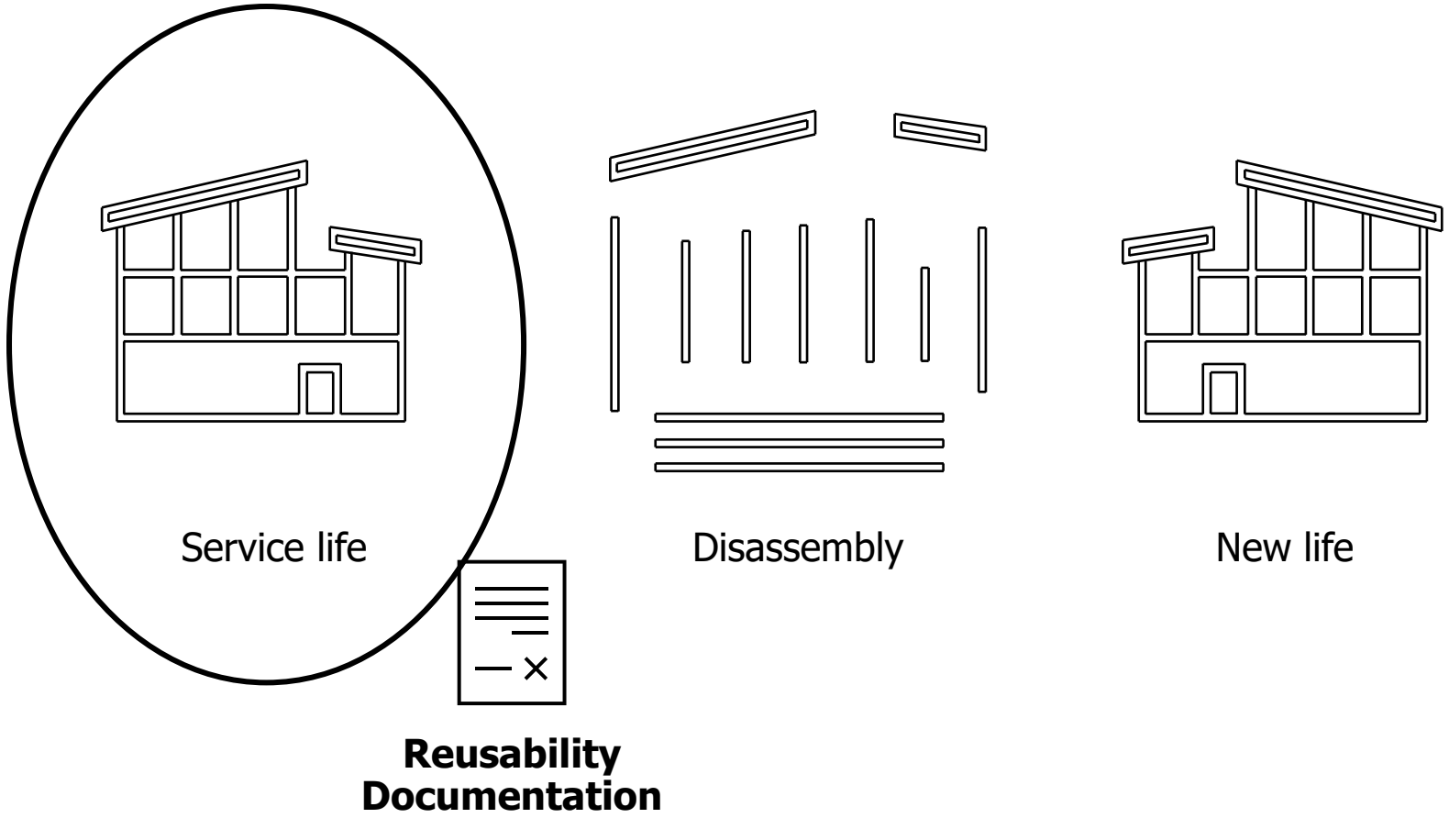


The StructuralReuse Consortium

Final Conference 12 September 2025

Documentation in the journey



2-Step Reusability assessment

1. Viability Assessment

- Quick Screening
- Decision to invest further

2. Quality Assessment

- Comprehensive testing
- Documenting required properties for design

NDT-based Reusability Assessment

Visual condition assessment

↓

Subsurface condition assessment


GPR


UPE

↓

Reinforcement assessment


GPR

↓

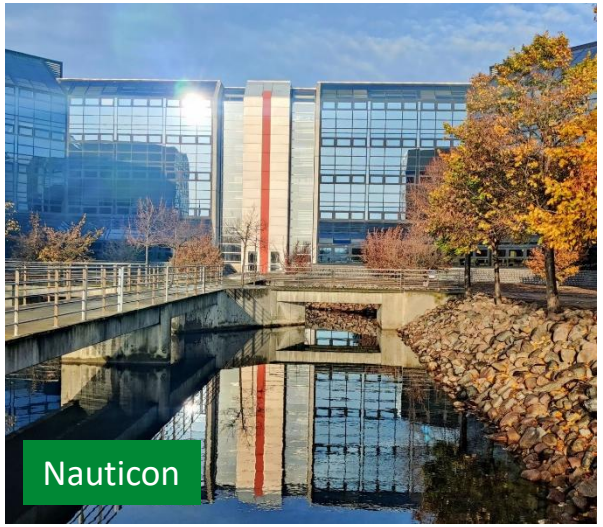
Compressive strength assessment


UPV


RH

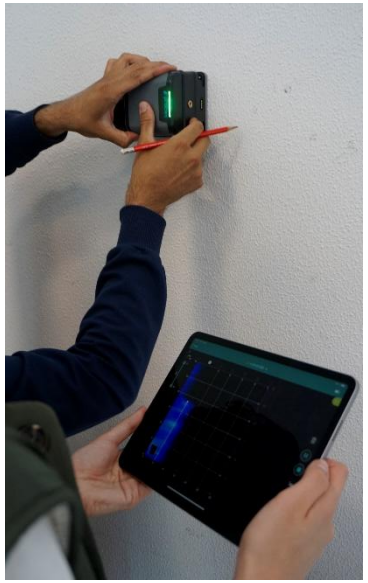
GPR: Ground Penetrating Radar, UPE: Ultrasonic Pulse Echo,
UPV: Ultrasonic Pulse Velocity, RH: Rebound Hammer

Case Studies

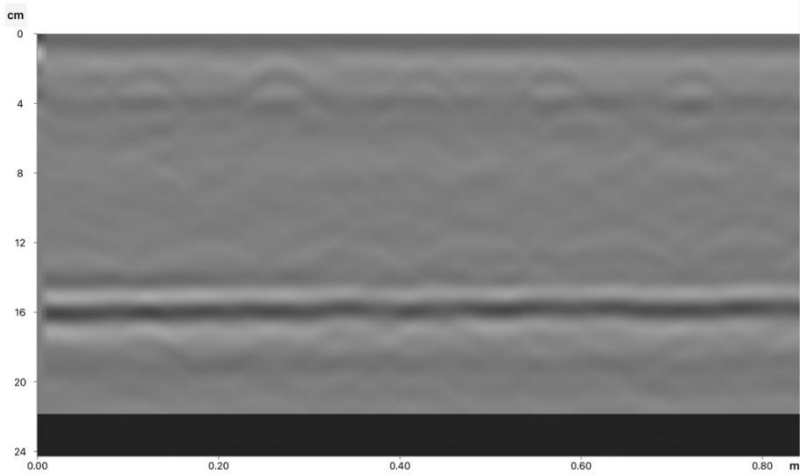


Subsurface Assessment

- GPR & UPE
  - Subsurface condition
  - Homogeneity

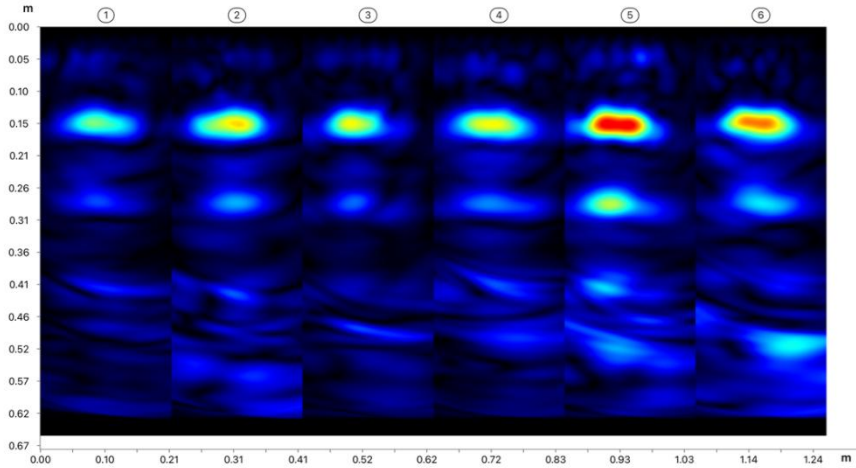


Ground Penetrating Radar (GPR)



Exemplary GPR Scan

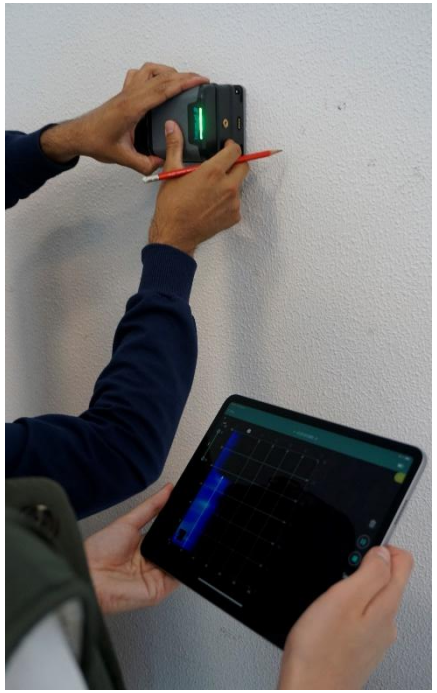
Ultrasonic Pulse Echo (UPE)



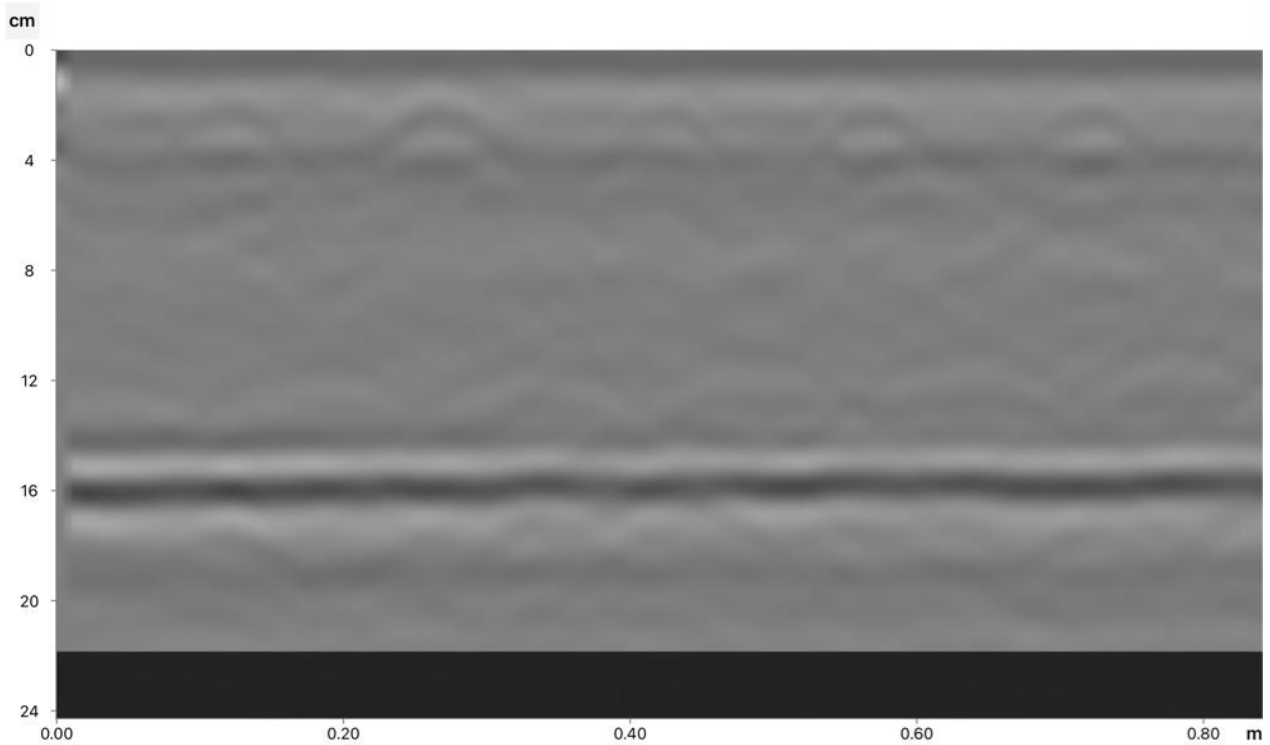
Exemplary UPE Scan

Reinforcement Assessment

- GPR with spot-check for calibration and validation



GPR
GP8800



Exemplary GPR Scan

Exemplary Removed cover

Compressive Strength Assessment

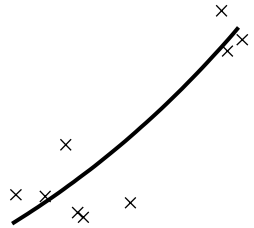
1. NDT,
2. Core,
3. Correlation

3-steps:

1. Non-Destructive Testing (NDT),
2. Core drilling and testing,
3. Correlation between NDT and Core strength

NDT

Core



Correlation

Compressive Strength Assessment

1. NDT,
2. Core,
3. Correlation

Non-Destructive Testing (NDT):

- Measuring properties correlated to compressive strength

Ultrasonic Pulse Velocity (UPV)

Rebound Hammer

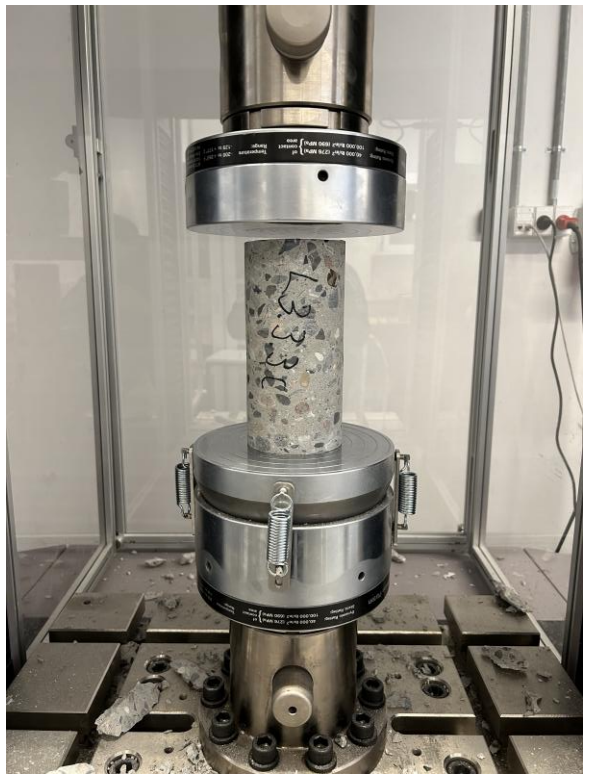
Compressive Strength Assessment

1. NDT,
2. Core,
3. Correlation

Core drilling and testing

- To measure "actual" properties

Drilling core



Compression Test

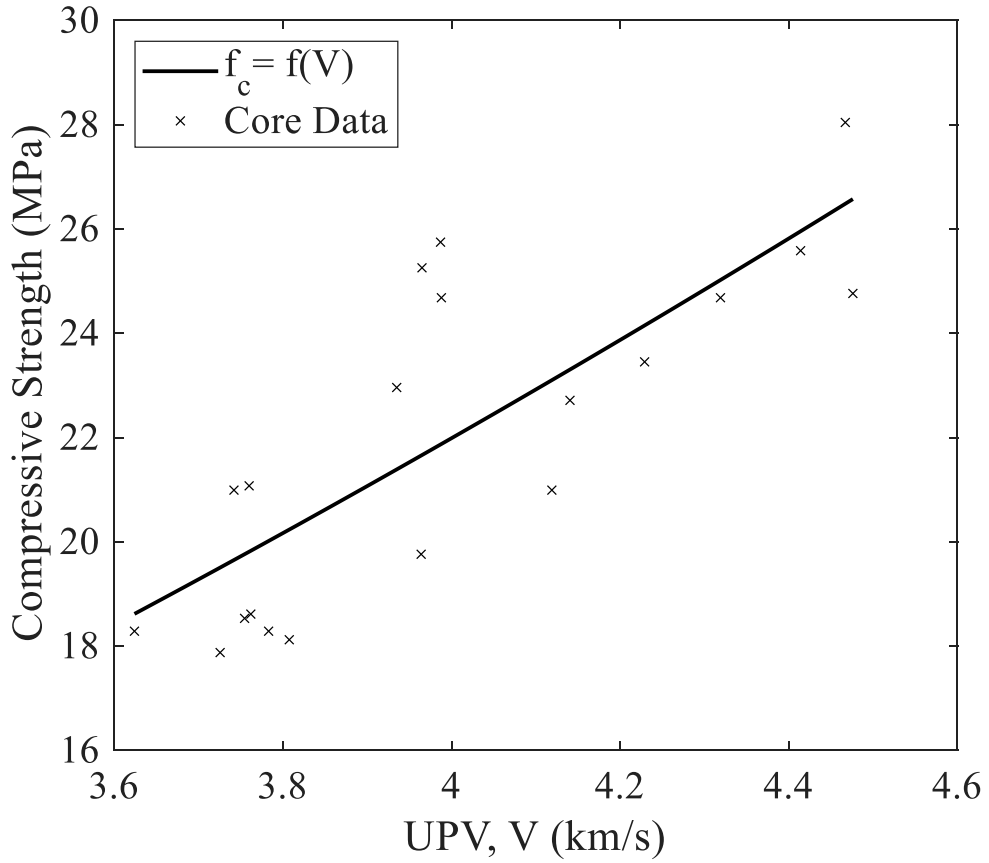
M. Klitdal, (2024), MSc Thesis, Reuse of structural concrete – documentation of mechanical properties by non-destructive testing

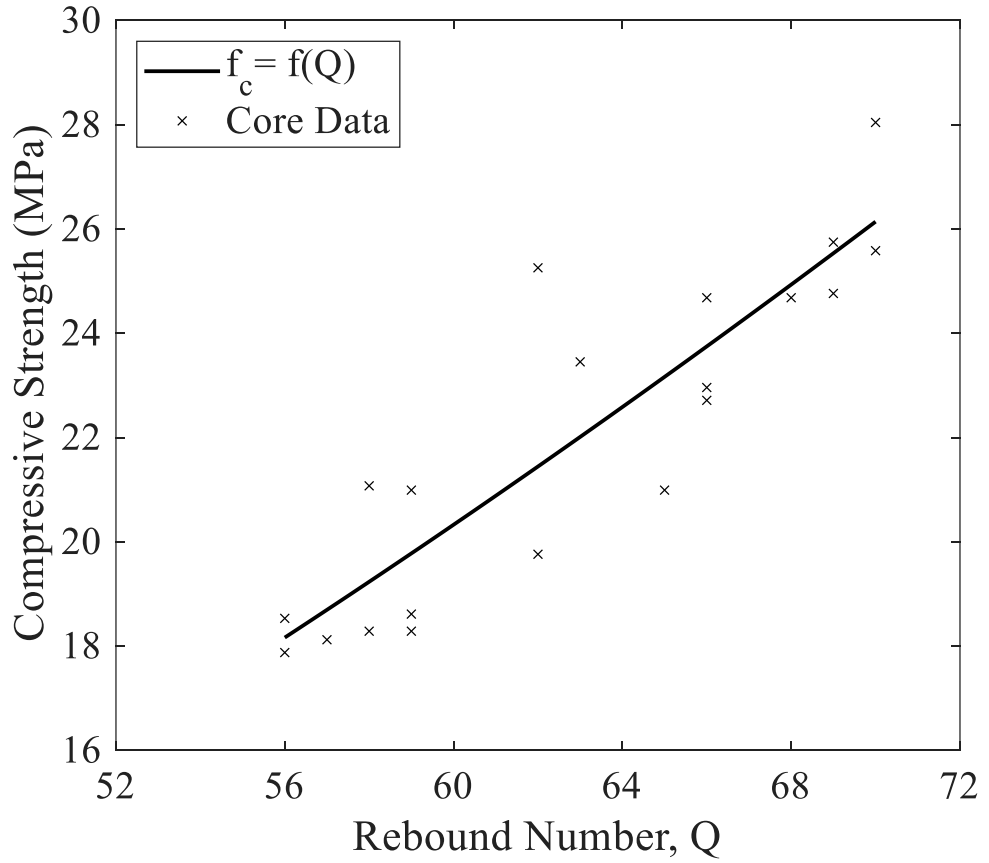
Compressive Strength Assessment

Correlation between core results and NDT

1. NDT,
2. Core,
3. Correlation

- From one of the case studies



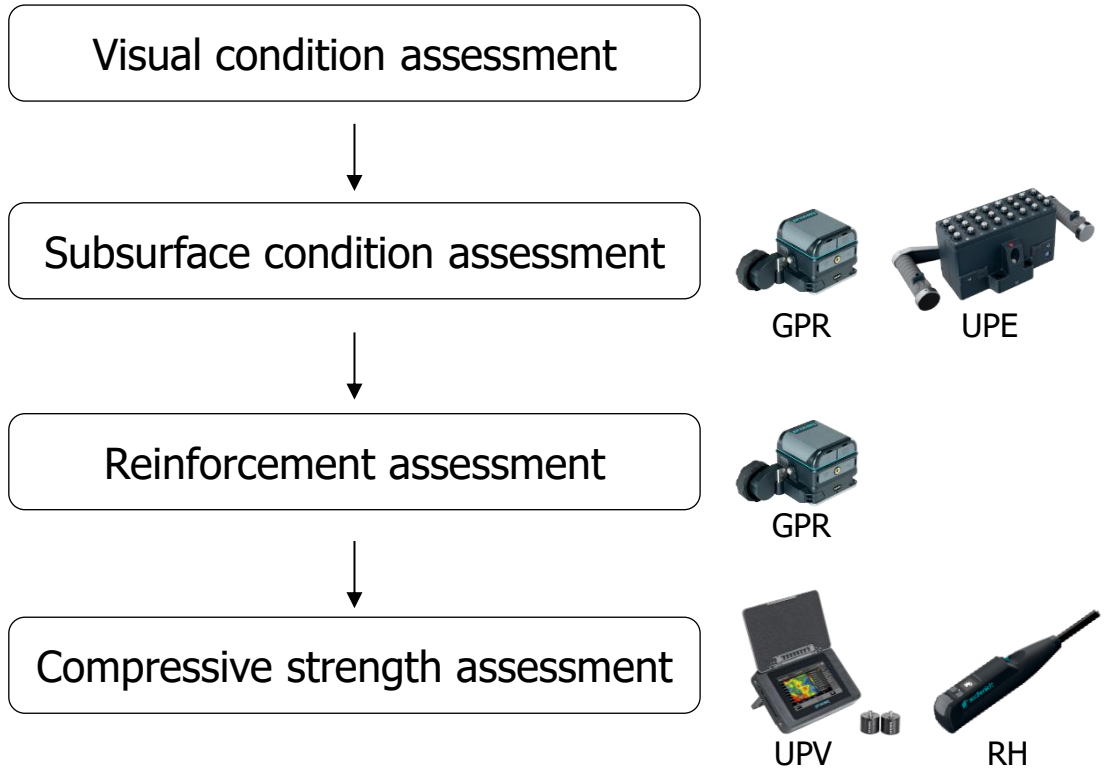


What if reliable and valid documentation exists?

- Structural calculations
- As-built drawings

Should we still perform full procedure?

- Visual Assessment & Reinforcement check?



GPR: Ground Penetrating Radar, UPE: Ultrasonic Pulse Echo,
UPV: Ultrasonic Pulse Velocity, RH: Rebound Hammer

Conclusion

- 2-step Reusability Assessment for safe and scalable reuse
  - Viability, quick screening
  - Quality, comprehensive testing
- Combined NDT: GPR, UPE, UPV, RH
- DS/INF 671
  - Developed and Validated through multiple case studies
- Comments/Feedback are needed to improve!

Acknowledgements

Would you like to contribute on our work by providing feedback?

Thank you for your attention ☺

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