TRUSS ITN

Workshop

CERI, UCD, Dublin

Wednesday 29th August 2018

Statistical reliability of the screw pullout test in the assessment of in-situ concrete strength

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Focus of the paper

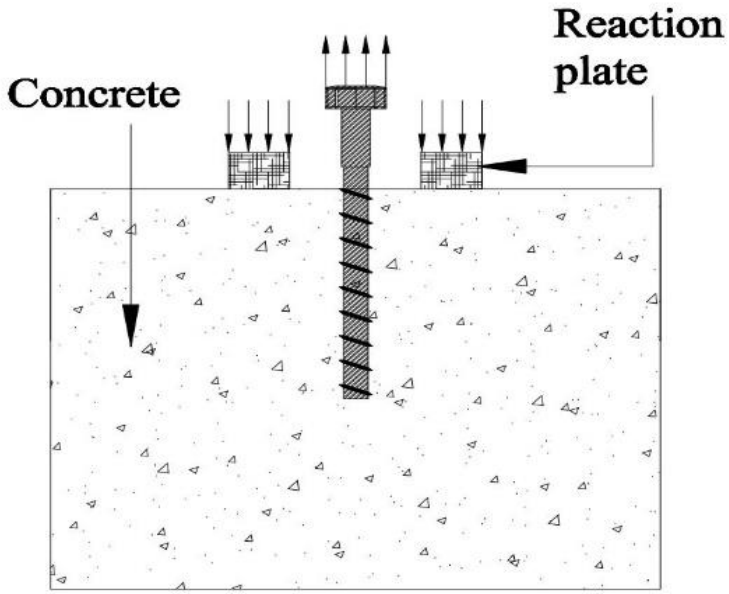
- Statistical properties of the test
- Factors influencing the test
- Repeatability
- Strength assessment and reliability

Research Background

- In-situ compressive strength of concrete
  - Core testing
  - Non-destructive tests (NDTs)
    - Indirect approach and uncontrolled factors
    - Empirical relationships
    - Lack of accuracy and confidence level
  - Core testing + NDTs
  - Time and costs

Post-Installed Screw Pullout (PSP) test

- Newly developed
- Partially destructive in nature
- HUS3-H8- a product of Hilti
  - Inner diameter-7.70 mm
  - Outer diameter-10.40 mm
- Hole diameter-9.0 mm



Post-Installed Screw Pullout (PSP) test

Concrete cone failure

Complete pullout failure

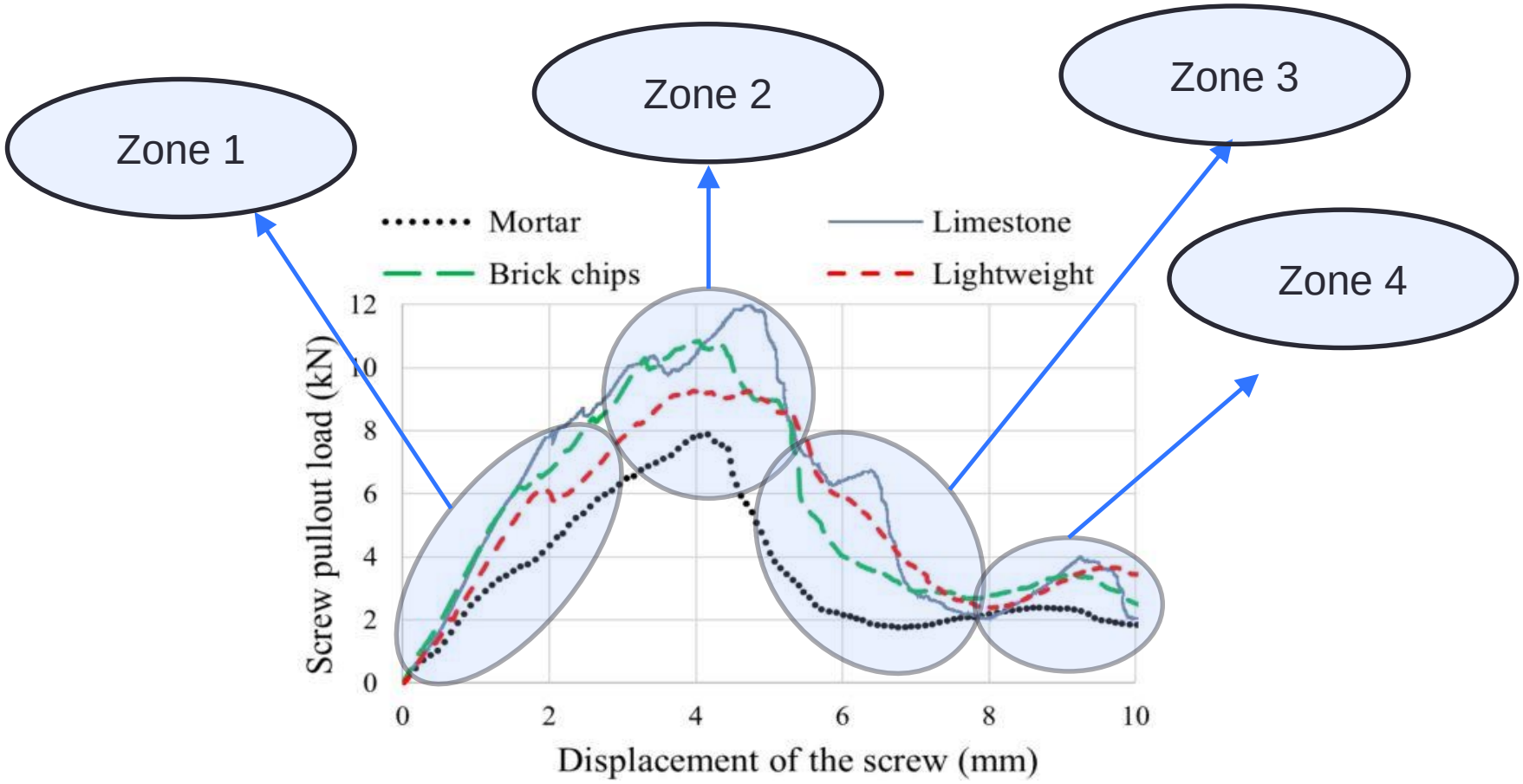
Post-Installed Screw Pullout (PSP) test

Experimental set up

Crushed concrete in between the threads

Post-Installed Screw Pullout (PSP) test

Load-displacement curve



Post-Installed Screw Pullout (PSP) test

Experimental investigation

- 73 batches of mortar & concrete
- 3 different aggregate types
  - Limestone, brick chips and lightweight
- 292 PSP tests
- Corresponding compressive strength tests

Post-Installed Screw Pullout (PSP) test

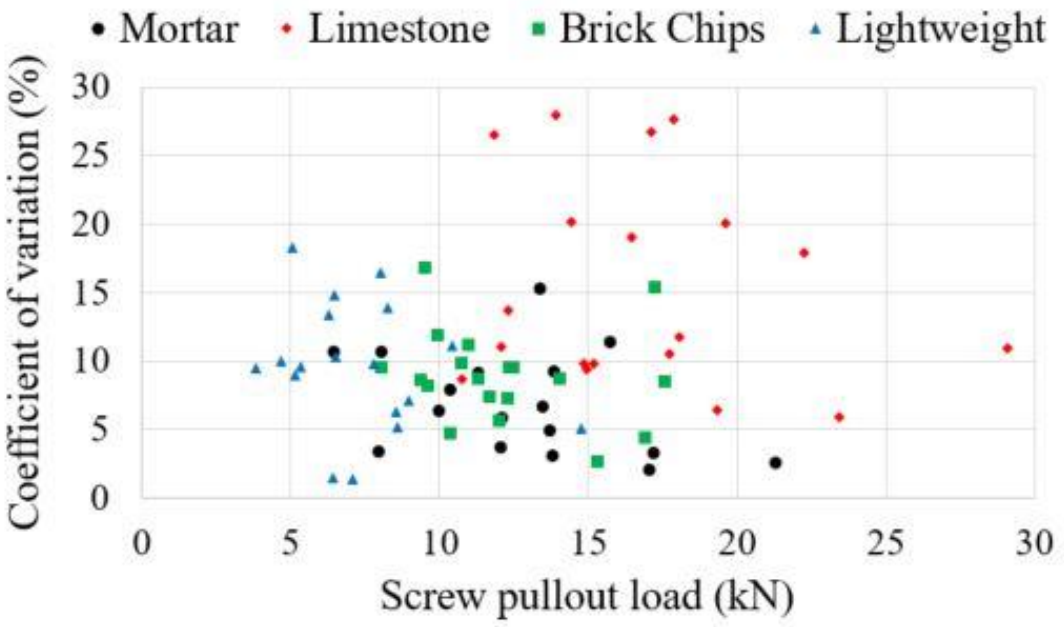
Factors studied

- Compressive strength
- Aggregate type
- Cement content
- Water-cement ratio
- Aggregate content
- Particle size distribution

Post-Installed Screw Pullout (PSP) test

Repeatability of the PSP test

- With-in test variation (CoV) as inherent scatter

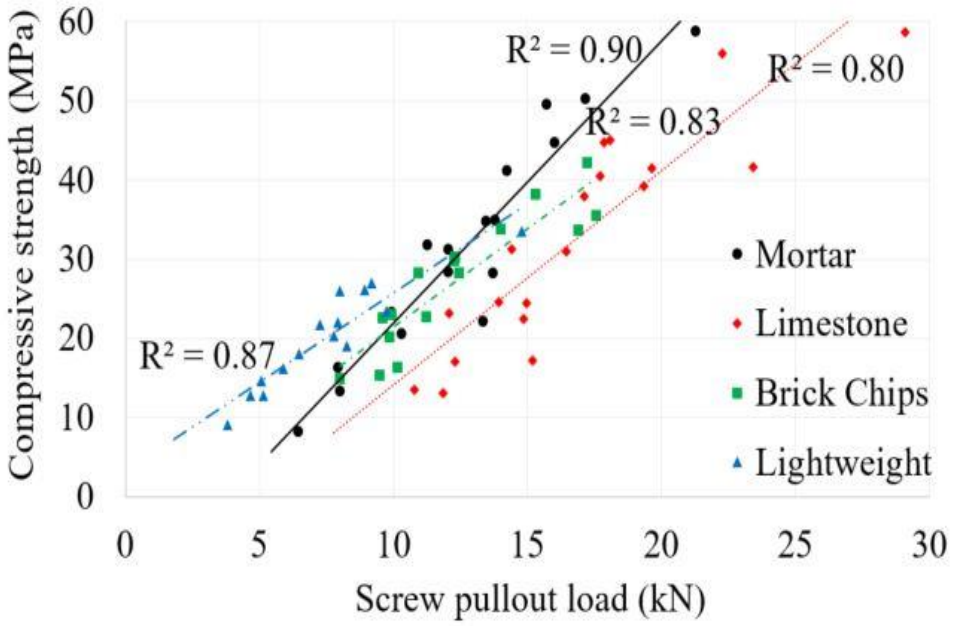


Aggregate	Mean CoV
Limestone	16%
Brick chips	9%
Lightweight	9%
Mortar	7%

Post-Installed Screw Pullout (PSP) test

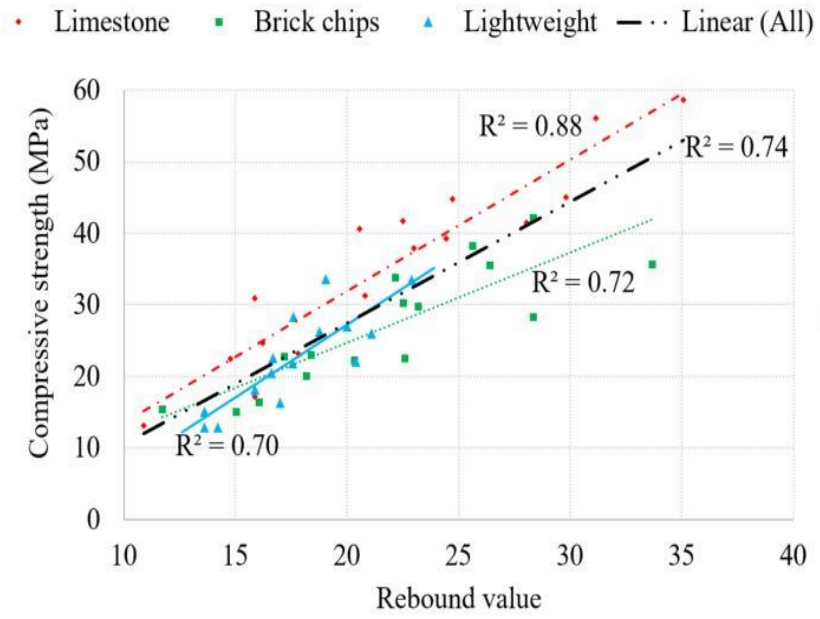
Strength relationships

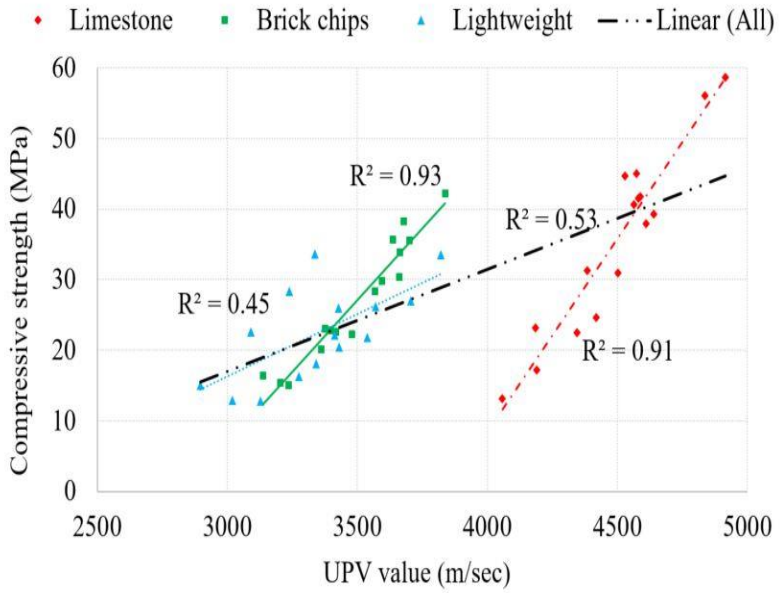
- Linear relationships considered
- Effect of aggregate type
- Type of relationship



Post-Installed Screw Pullout (PSP) test

Rebound hammer and UPV





Post-Installed Screw Pullout (PSP) test

Statistical properties

Aggregates	R-sq	Mean Residual (MPa)	RMSE (MPa)
Mortar (No aggregate)	0.90	3.24	4.47
Limestone	0.80	4.98	6.29
Brick chips	0.83	3.40	3.33
Lightweight	0.87	1.90	2.28
All	0.73	5.26	6.83
All except mortar	0.75	4.70	6.13

Conclusions

- Cost effective in compared to core test and other NDTS
- Harder the aggregate, higher the CoV
- No effect of compressive strength on the repeatability
- Only aggregate type has direct influence on the test
- R-sq values are greater than 0.80 when produced separately based on aggregate
- Mean residual less than 5 MPa in every case
- Potential to be reasonably accurate and reliable

Thanks for your attention

The TRUSS ITN project (http://trussitn.eu) has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 642453