TRUSS ITN

Reducing Uncertainty in Structural Safety

Special Session SS6

Ghent, Belgium
28-31 October 2018

IALCCE 2018

Use of post-installed screws in the compressive strength assessment of in-situ concrete

Md Shah Nur Alam Sourav, Salam Al-Sabah and Ciaran McNally

ARUP

UCD DUBLIN University College Dublin

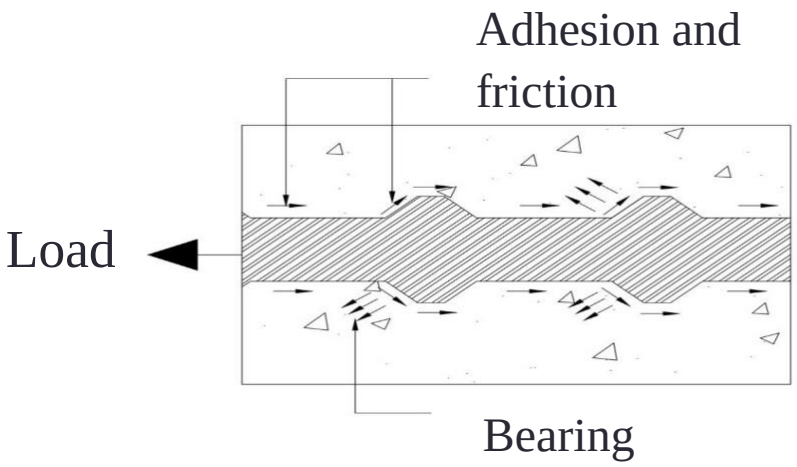
Outline of the paper

- Bond strength of deformed rebar
- Post-installed screw in concrete
- Post-installed Screw Pullout (PSP) test
- Experimental investigation
  - Statistical properties of the PSP test
  - Factors influencing the PSP test
  - Strength assessment and reliability

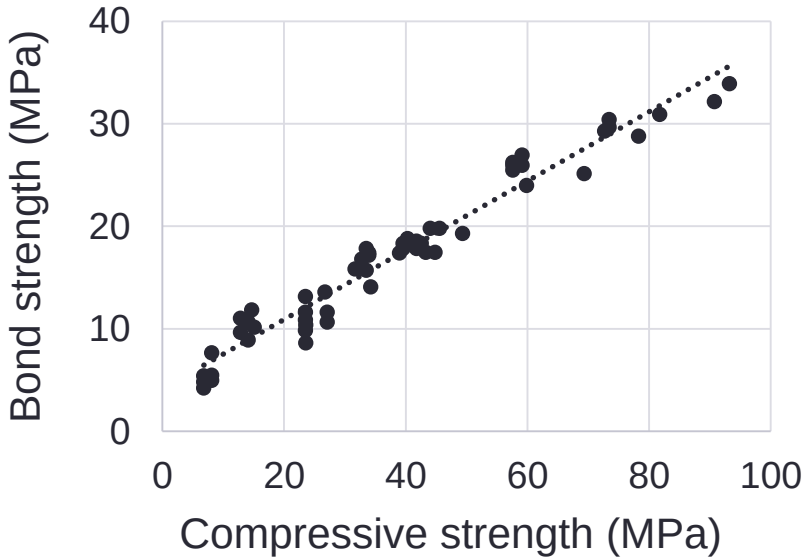
Research Background

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

Bond strength of rebar

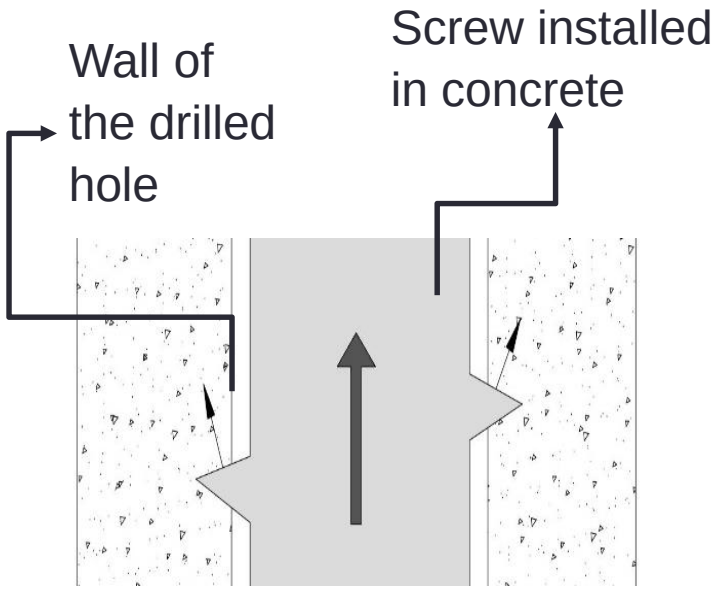


Complete Pullout Failure



Post-installed screw in concrete

- Screw cuts threads in the wall of the hole
- Load transfer by bearing mechanism of screw threads
- Mechanism is similar to bond action of deformed rebar



Bearing Mechanism of screw in concrete

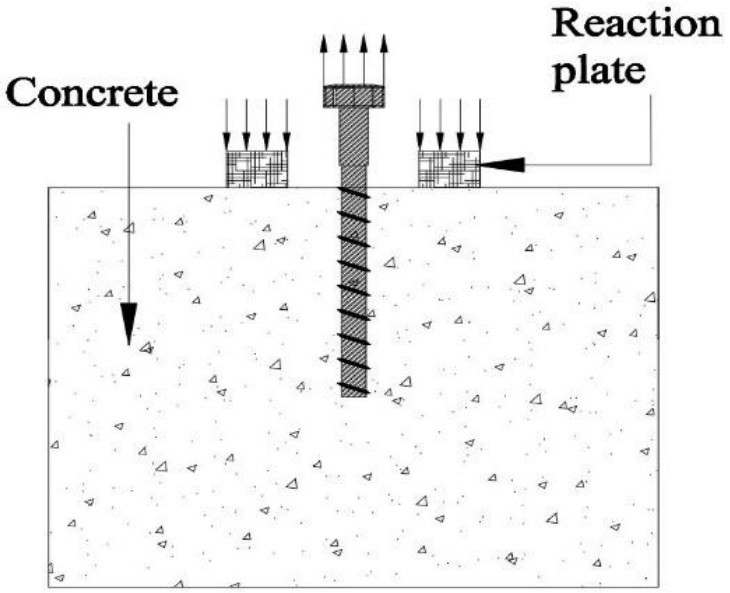
Post-Installed Screw Pullout (PSP) test

Concrete cone failure

Complete pullout failure

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
- Hole depth-70 mm



Post-Installed Screw Pullout (PSP) test

Experimental set up

Crushed concrete in between the threads

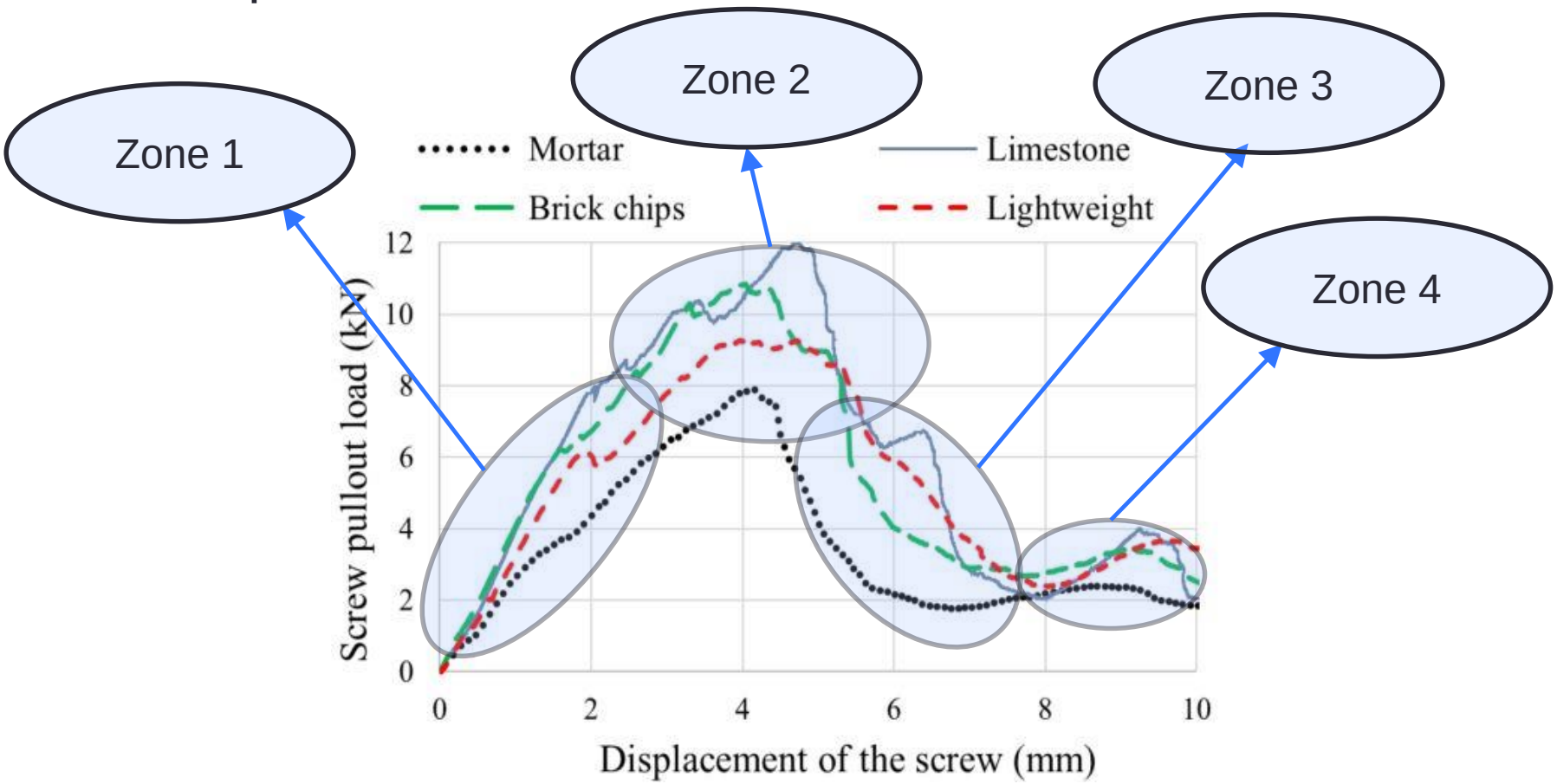
Post-Installed Screw Pullout (PSP) test

Factors studied

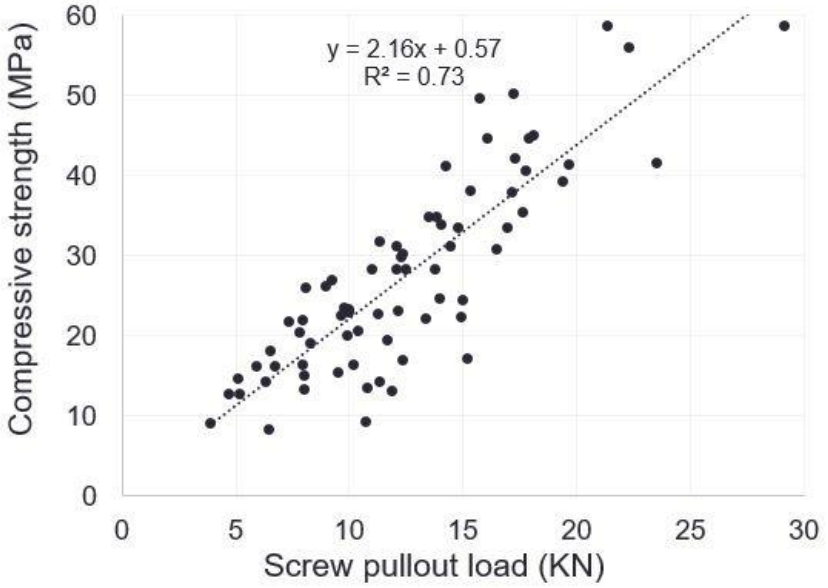
- Compressive strength
- Aggregate type
- Cement content
- Water-cement ratio
- Aggregate content
- Particle size distribution

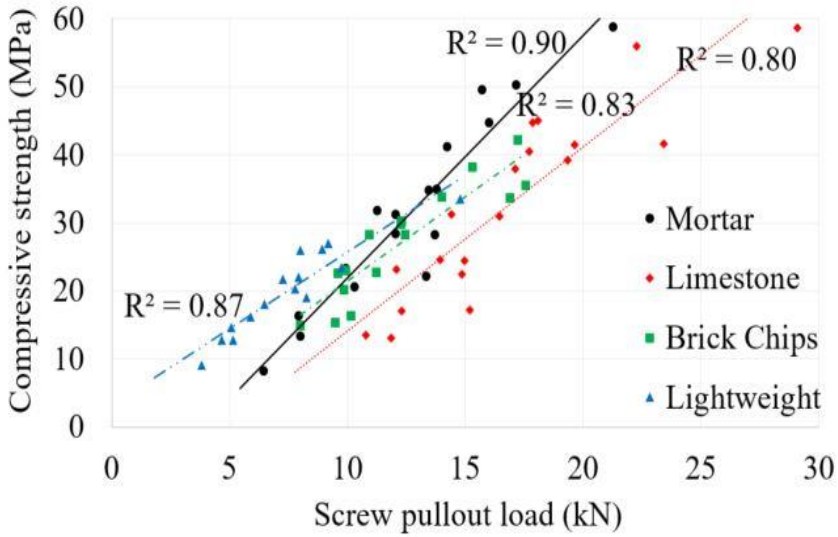
Post-Installed Screw Pullout (PSP) test

Load-displacement curve



Post-Installed Screw Pullout (PSP) test





Effect of aggregate type

Damage on the threads

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

Conclusion

- Cost effective in compared to core test and other NDTs
- High strength correlation when considering the aggregate types
- Load carrying behaviour affected by aggregate type
- Harder the aggregate, higher the variation in results
- High repeatability and reliability in concrete with softer aggregates
- 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