

# The Insidious Nature of Pressure Transients

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## Project background

Reducing leakage is a key component in improving the sustainability and resilience of networks.

**This project is investigating if and what types of low amplitude transient activities can cause leaks in cast iron pipes.**

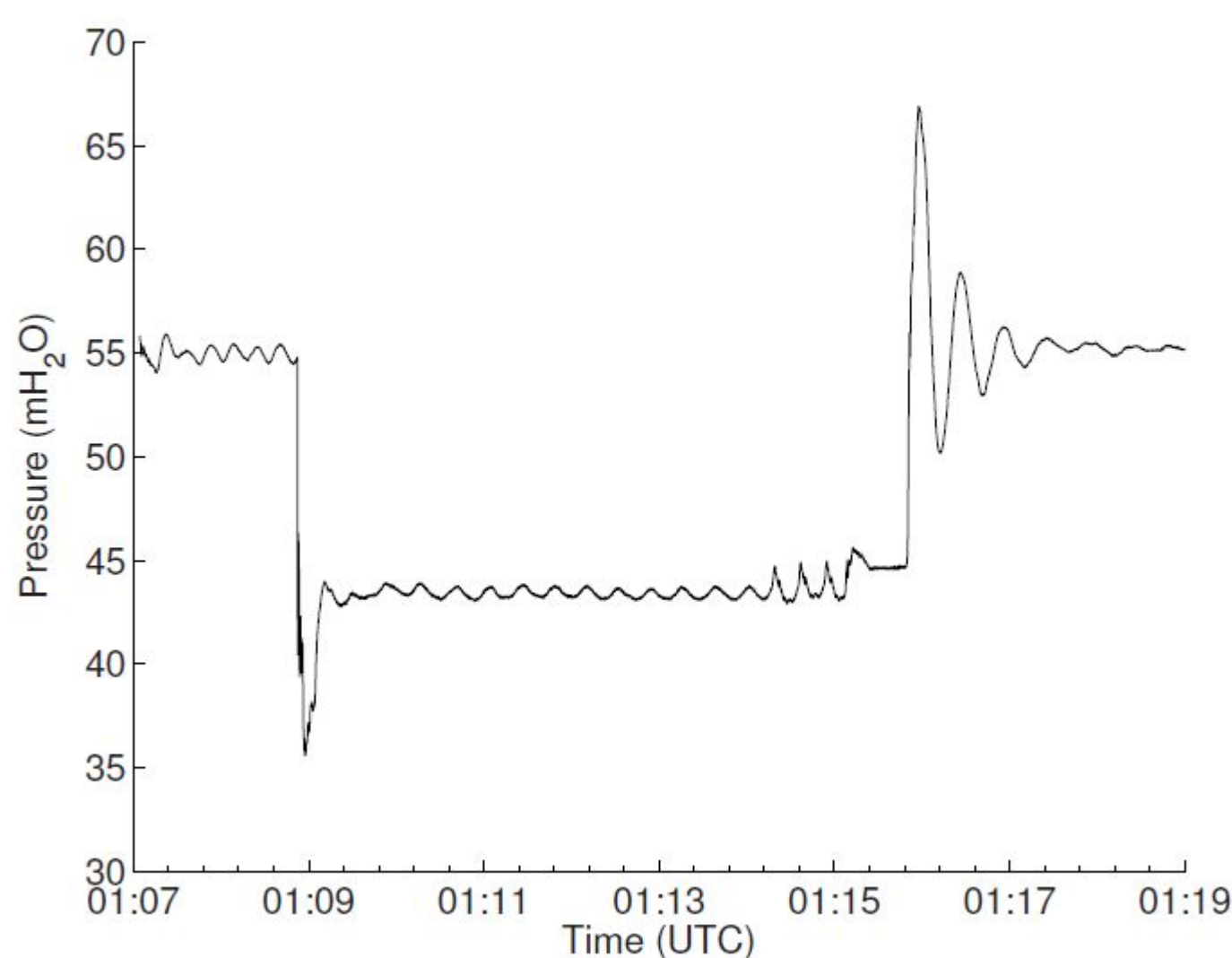
### Why cast iron pipes?:

- Estimated to still be 60% of the UK network<sup>1</sup>.
- Cast iron pipes exhibit high failure rates<sup>2</sup>.

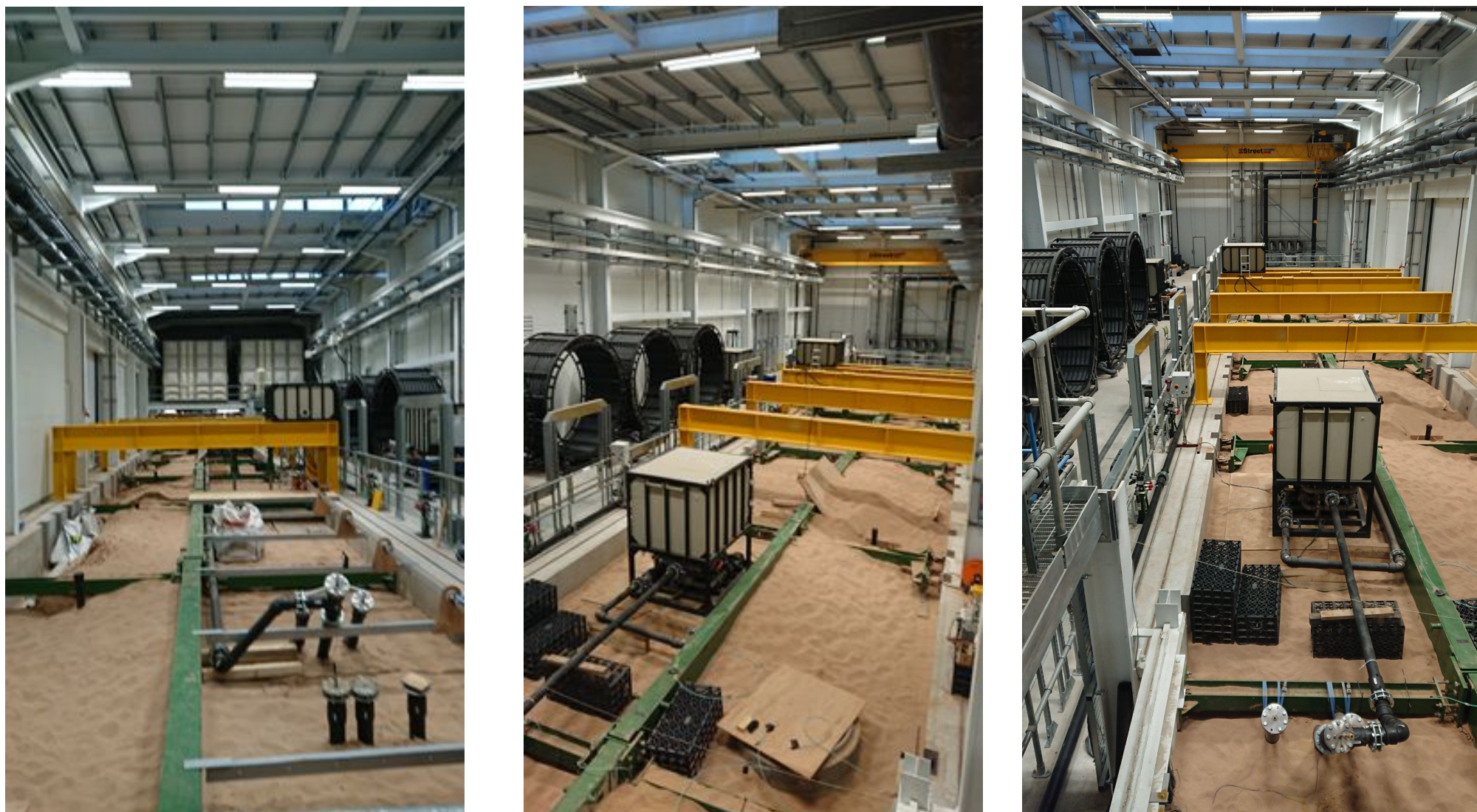
### What is a transient?

Transients are pressure waves which arise from a sudden change in flow within a section of the network.

An example of a pressure transient showing both the drops and rises in pressure during the event, note the damping occurring due to friction. Image source: InfraSense: a distributed system for the continuous analysis of hydraulic transients, 2014



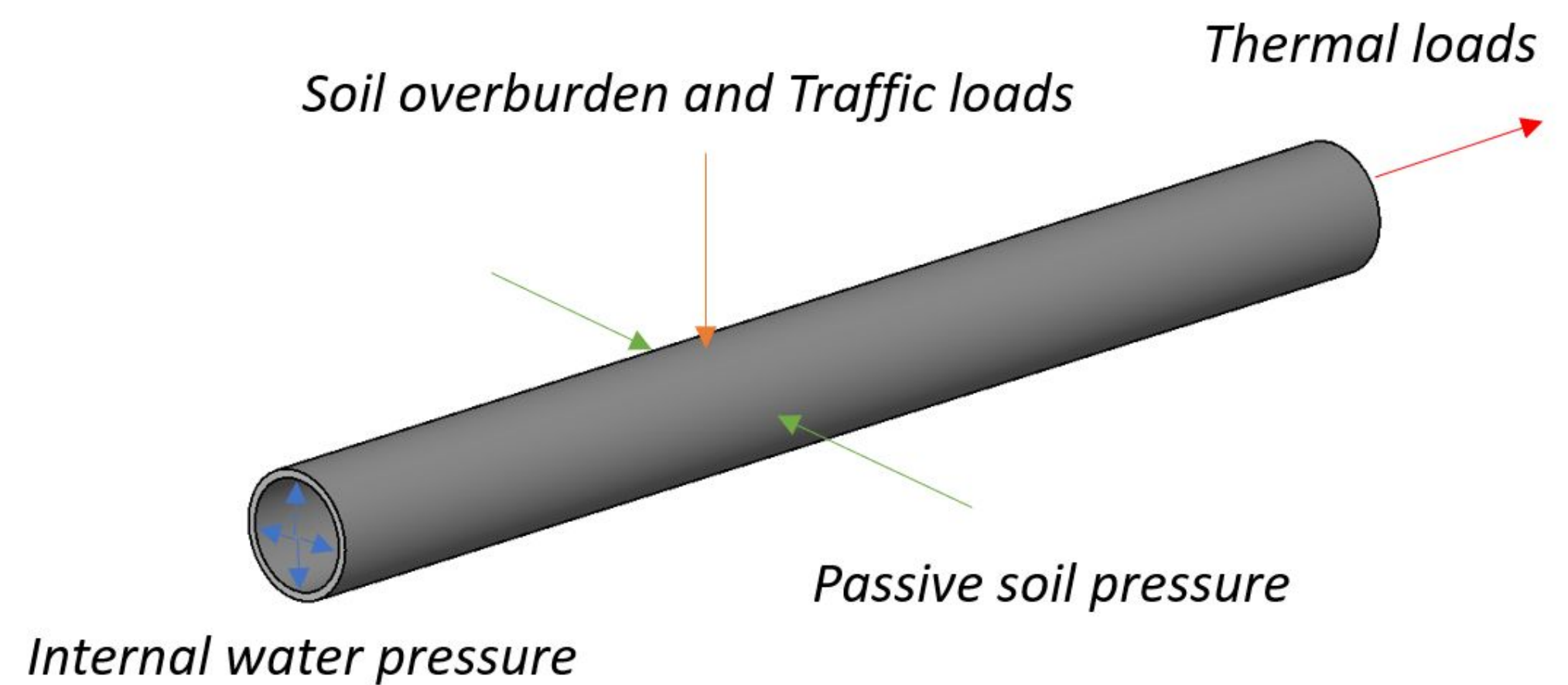
- Postulated as a loading source for fatigue. Leaks due to fatigue can go undetected for years.



The new ICAIR facility, capable of recreating real network conditions. Images courtesy of Dr Richard Collins, The University of Sheffield

## Project aims

Pipes are subject to a range of variable loadings:



Examples of loads which can vary temporally across the length of a buried pipe.

This project aims to answer:

- What types of transient cause fatigue damage?
- Are different regimes more problematic?
- What loading combinations are most problematic?

Validate stress models with physical experiments and numerical modelling.

Fatigue analysis for transient regimes identified in real networks.

Rank transient loading scenarios by potential fatigue damage.

## Current and Future Steps

- Small experiments investigating the impact of boundary restraints on pipes during transients.
- Full-scale buried tests at the state-of-the-art ICAIR facility (bottom left). An exciting opportunity to replicate sections of pipe networks.

## Project Impact

Developing stress models for pipes subject to identified transient regimes allows more damaging scenarios to be highlighted. This will inform future mitigation activities, improving asset management and reducing leakage.

## References

<sup>1</sup>Li, C. Q. and Mahmoodian, M. (2013). Risk based service life prediction of underground cast iron pipes subjected to corrosion. Reliability Engineering and System Safety, 119:102-108.

<sup>2</sup>Wasim, M., Li, C.-Q., Robert, D., and Mahmoodian, M. (2020). Effect of Soil's Acidity and Saturation on Degradation of Fracture Toughness of Buried Cast Iron. Journal of Materials in Civil Engineering, 32(7):04020180.