Water Displacing Backfill Material to Expedite Works

Thames Water Lane Rental Industry Publication

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Introduction

Water is a vital part of everyday life, to wash, cook, clean and drink. Ensuring the water network operates effectively requires Thames Water to carry out approximately 127,000 street works each year. While everything is done to expedite works, there are occasions where this isn't possible due to water getting into excavations, causing delays.

However, this is not always because of a faulty asset. It can often be caused by external factors, such as a customer side leak, adverse weather conditions or existing water tables. When this occurs, the water needs to be pumped out before the excavation can be backfilled and the area reopened to traffic, requiring additional time on site. It's a universal problem for all utility companies undertaking street works.

Working collaboratively with SQS, Thames Water set out to develop a backfill material which could displace water, allowing it to find a natural path around the area of operation and subsequently enable reinstatement to be achieved quickly.

The Project

The project was led by the UK's expert in hydraulically bound material and consisted of investigation, design, trials and testing phases.

While the overall aim was to develop a backfill material capable of displacing water, it also needed to meet the following criteria:

- sufficient strength to allow early overlay of the surface course
- adequate strength for load-bearing under live traffic
- strength not so excessive, to enable excavation in the future should it be necessary to expose an asset.

It was proposed that part of the cement content be replaced by fly ash, a legacy by-product of the coal industry, which usually ends up at specialised landfill stores. Lab tests were carried out to identify the suitable mix capable of displacing water, while still able to hold its shape and reach the required strength. Samples were tested for compressive strength.

Site trials were then performed to ensure that the laboratory findings could be replicated in field conditions and to confirm the suitability of a volumetric mixer for large batches. Samples were again tested for compressive strength.

Outcomes

The final material was similar to foamed concrete (low strength and self-compacting) but could be placed directly into wet conditions or water, including flowing water, and displace it without segregation.

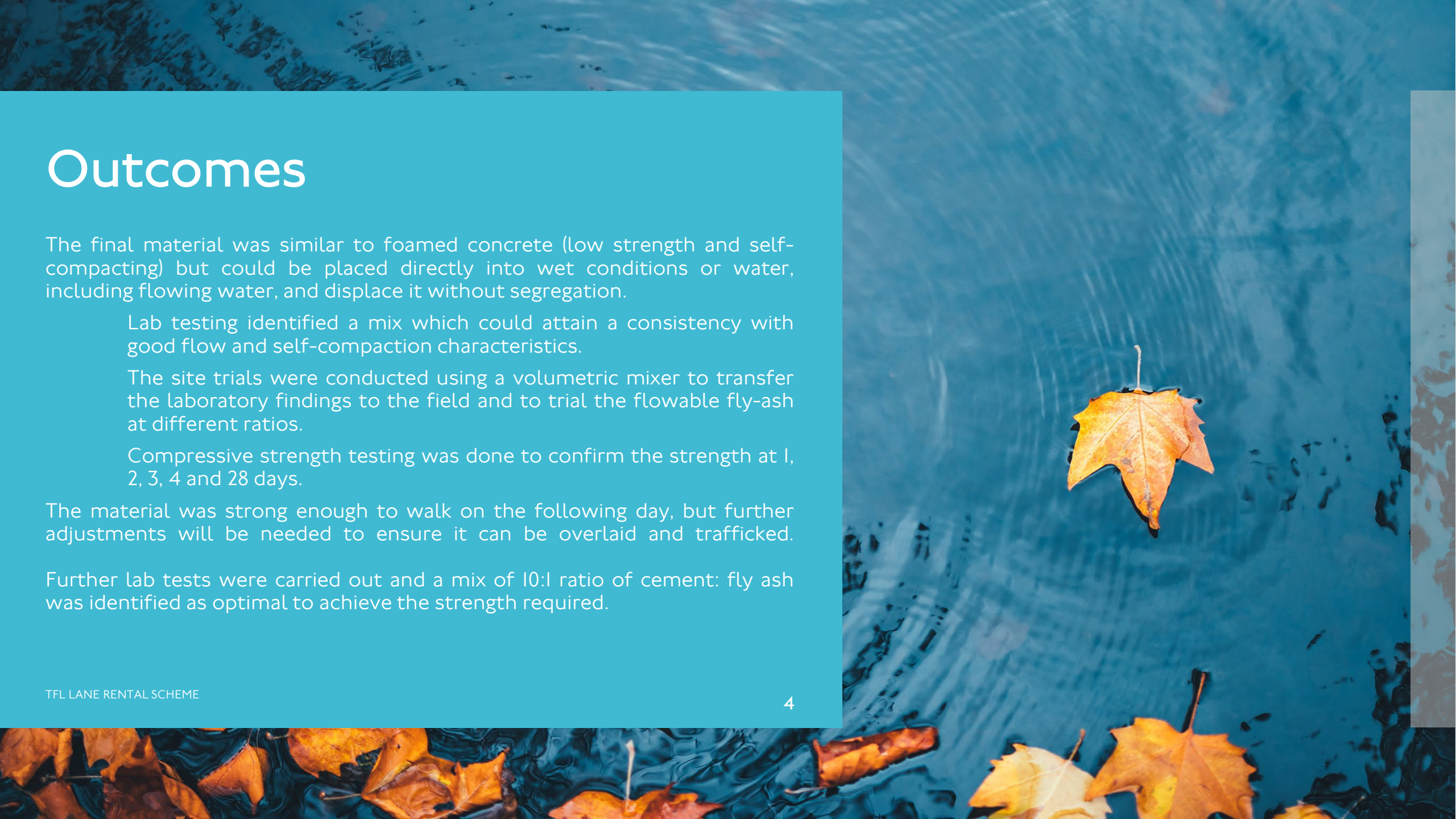
Lab testing identified a mix which could attain a consistency with good flow and self-compaction characteristics.

The site trials were conducted using a volumetric mixer to transfer the laboratory findings to the field and to trial the flowable fly-ash at different ratios.

Compressive strength testing was done to confirm the strength at 1, 2, 3, 4 and 28 days.

The material was strong enough to walk on the following day, but further adjustments will be needed to ensure it can be overlaid and trafficked.

Further lab tests were carried out and a mix of 10:1 ratio of cement: fly ash was identified as optimal to achieve the strength required.



Lessons Learnt

The site trial found that the material was a challenge to mix in the volumetric mixer machine. The machine batches material by volume, not weight and produces the material using a screw within a tube (like an Archimedes' screw) which clogged the tube over time. This was addressed in the second site trial by manually agitating the mix. As a lesson learnt it may be necessary to alter the equipment to prevent the need for manual intervention or other methods of production could be explored.

Conclusion

The project was considered an overall success as it:

- Identified the suitability of a flowable backfill for displacing water
- Established that there is a plentiful supply of fly ash for future use
- Showed that the delivery method could be scaled up, by use of a site trial
- Confirmed that the required strengths could be met
- Identified an optimal mix at 10:1
- Established a potential delivery method with the volumetric mixer

The results of the project were very satisfactory. It demonstrated a material that delivers as a backfill for street works reinstatements which will work in wet conditions, displacing water while self-levelling and reaching sufficient strength requirements.

The next steps are to refine this process to establish if the mix of 10:1 of fly-ash to cement could be utilised in the field and to enter it for testing to get industry adoption under Appendix A10 of the Specification for the Reinstatement of Openings in Highways as a hydraulically bound material, or A9.

Once adoption has been realised statutory undertakers will be able to utilise the material for backfill during wet conditions, enabling the return of use of the highway back to the public sooner. In addition, it could remove the requirement for storage of fly ash, reduce the emissions associated to the reinstatement, speed up the opening of the road and reduce disruption to the travelling public.

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TfL Lane Rental Scheme

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