Highway filter drains maintenance management

The presence of water on the surface or in the foundations of a highway pavement can lead to safety and structural problems with the road’s operation (for example: reduced visibility, loss of wheel adhesion, accelerated structural deterioration). The pavement and sub-surface of many UK highways are drained by highway filter drains (HFDs). These are gravel filled trenches fitted with a porous carrier pipe at the base to remove surface and sub-surface water from the pavement system. Research at Loughborough University is determining how to manage the maintenance of such systems effectively.

HFDs are typically characterised as free draining upon construction; however, over time the voids of the granular medium become partially or wholly filled due to the intrusion of fines washed from the adjacent earthworks or pavement surface. Current UK design guidance expects HFDs to have an operational life of 10 years, while within some long-term maintenance contracts (20-30 years), the hand-back requirement may include a 5-year HFD residual life at contract end.

However, there are currently no standard methods or techniques to assess the asset’s in-service performance or residual life. With no appreciation of how fouling progresses within an HFD, and with a lack of understanding of the deterioration mechanisms or a structured fouling characterisation, the assessment of operational and residual HFDs’ life is limited to subjective or generic estimations of the in-service performance. This extends to maintenance procedures that are often reactive rather than proactive. Maintenance treatment strategies normally range from scarifying the top 100mm of the drain, to full replacement of the “contaminated” filter drain material with new media.

Planned maintenance activity on the HFD network is often based on engineering judgement rather than the adoption of systematic and formalised maintenance management practices (e.g. condition performance monitoring, life-cycle cost analysis, optimisation and financial planning).

The current practice, and in general the design and maintenance guidance documents, fall short of addressing the integration of performance standards, minimum acceptable levels of service effectiveness and operational / residual life. This imposes the practical query of whether the current maintenance and technical regimes enable asset managers to export the full extent of the asset’s life value or fail to address its gradual deterioration and the impact of this on the in-service performance of the drain.

To address these issues, a study is being undertaken at the Centre for Innovative and Collaborative Construction Engineering by Theodoros Stylianides under the supervision of Dr. Matthew Frost and Dr. Paul Fleming. The research is being conducted as part of the Engineering Doctorate programme at Loughborough University and co-sponsored by Balfour Beatty, Transport Scotland, the Engineering and Physical Sciences Research Council (EPSRC) and Pavement Testing Services (PTS).

The study aims to develop a maintenance evaluation and monitoring system to allow the establishment of predictive maintenance techniques for highway filter drains and of a system that allows the performance of HFDs to be routinely evaluated and monitored with the aim of improving performance and introducing sustainable maintenance thinking in the current business model.

This should ensure that effective maintenance regimes are implemented and foster more-sustainable use and reuse of materials. The study aims to build on field evaluations and investigation of the performance of the asset. It will do this through a combination of destructive and non-destructive assessment of the condition of the drains, permeability and hydraulic experimentation of the fill, and evaluation of the fouling characteristics that have an impact on the in-service performance of HFDs.

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