

Langport Embankment Stabilisation

Improving the
resilience of the
operational railway



Issue

The Langport Embankment in Somerset was experiencing track settlement and general subsidence, putting the mainline railway above at risk of speed restrictions and closures. The embankment carries key passenger and freight services between London Paddington and Exeter St. Davids, hence remedial measures to arrest the movement and provide resilience of this critical part of the rail network were needed.

Network Rail Wales and Western appointed Suttle Projects as Principal Contractor to undertake the £11.5m safety critical embankment remediation works. The total embankment length is 1.25km, stretching either side of the River Parrett, and reaching 8 metres above the surrounding flood plain, an area of sensitive ecological and environmental interest. The works would be delivered in three phases over a two-year period, and upon completion would guarantee the long-term reliability of rail services at this important location.

A project of this nature will always bring challenges and our approach to simplifying projects would prove to be invaluable, in mitigating risks, respecting the sensitive environment and achieving a safe and successful delivery of the technically complex stabilisation solution.

Through focussing on reliable deliverables, maximising productivity and providing creative problem solving, an innovative piling technique was developed, that could be used without closure of the railway. This technique resulted in significant cost and programme savings at Langport, and would later be adopted nationally, transforming working practice adjacent to open railway lines.

Solution

The design solution to contain and arrest the subsidence included several different safety critical elements along the length and height of the embankment. Our innovative methodologies for piling, excavation, backfill and drainage enabled the stabilisation project to be undertaken almost entirely with the railway fully operational.

This provided significant benefits in cost and programme, with only one major blockade used over Easter to complete the track level works. Our in-house geotechnical expertise, self-delivery, owned and maintained plant and equipment allowed us to simplify the project, providing certainty of cost, programme and capability, and ensuring risks were proactively identified, and mitigated or removed.

Reliable Flood Plain Access and Working Areas

The first challenge was to access the failing embankment which was located in a flood plain and required close consultation with the

Environment Agency (EA) and granting of a Flood Risk Activity Permit. The temporary access road and working platforms had to withstand heavy construction plant and the transportation of substantial volumes of materials, hence were of significant construction depth that necessitated careful design in accordance with the requirements of the EA to avoid creating any flood risk.

We constantly strive to increase productivity and in the stand down period between project phases we researched and identified a long-reach telescopic piling rig that was new to the market. The in-house temporary works design was reconsidered and it was concluded that adoption of this new technology would enable us to reduce the level of the temporary working platforms on the next phase of the project.

This creativity avoided 10,000 tonnes of imported materials saving significant cost, time, carbon emissions and disruption to the local communities.

Creative Piling Methodology

The final solution required the installation of over 800 metres of sheet piling up to 23m in length, either side of the embankment. This was 22% more piling than was originally specified and was incorporated without extending the programme.

The handling of 23m long piles in such close proximity to the running lines, presented a high risk of piles encroaching the railway and as such would conventionally have been completed with all train movements stopped.



To address the limitations of working in this way, we developed an innovative piling “gate” solution that acted as a physical barrier to prevent this from happening and opening efficient, more productive daytime working, also of major benefit to the local community.

The gate could be installed entirely with fix jaw virtual box slew restricted plant and consisted of 457x191x61 UB 13m long vertical piles and horizontal beams welded together, with a Tirfor rope installed along the top of the gate.



To further manage the risk, we installed the first pile during a line block, trialling the selected methodology without risk to trains, which was subsequently approved by Network Rail for live implementation.

To facilitate pile installation at the mid-slope position, the embankment was benched in 20m sections to minimise the risk of any temporary instability. The piles were initially installed to refusal using the leader rigs and then a crane suspended impact hammer was used to back drive the piles to their design depth.

The area was then backfilled with 6N and Class 1A material and regraded above the piles. The piles were then tied back with deep grouted soil anchors installed at 30-degree angles which varied in length between 9.0m and 11.5m.



A further retaining wall system was required at high level, adjacent to the cess. This work was successfully completed over a seven-day continuous closure of the railway over the Easter period.

This upper structure was designed to retain the track ballast and constructed of 2.8m steel T-sections, with GRC ballast boards spanning in between. The structure was installed utilising a rail mounted excavator with Movax side grip attachment. A twin wall pipe and catchpit system was then provided behind the ballast boards to improve and future proof the embankment's drainage.



A new precast concrete troughing system served to protect the existing signalling cables and also created additional retaining support to the ballast shoulder of the railway. Our work scope also included lifting and tamping of the permanent way, ballast wall, capping beams and safety handrails.

Throughout the construction works, our engineers regularly monitored the permanent way and results were submitted to specialist Network Rail engineers for analysis and interpretation. Our survey work was supplemented with the use of an automated slope monitoring system using Senceive tilt sensors.

This creative Suttle Projects solution removed railway operational risk, significantly increased productivity and was a critical element for approval of the Adjacent Line Open working regime. This innovative approach resulted in significant cost and programme savings and would prove to be a forerunner to the solution that is now widely adopted across the national railway network.

On Site Recycling

As much waste material as possible was recycled at source, through creating an onsite quarry and recycling facility. We used the expertise of our sister company Suttle Stone Quarries; a dedicated aggregate producer and specialists in recycling construction soils and demolition waste who operate their own materials recycling plant in Dorset. This localised processing enabled 15% of waste material to be reused back into the permanent works. In addition, by creating a valuable recycled product, we were able to supply the local construction industry, with the sales receipts fed directly into the project cost savings.

This innovation was instrumental in creating an environment of enormous trust with our client, demonstrating our commitment to achieving





common project objectives whilst supporting social value initiatives. Through carefully managing the importation and sustainable disposal of 90,000 tonnes of temporary works materials, less than 0.4% of waste was sent to landfill.

Identifying Design Inconsistencies Early

A key element of simplifying projects is our Suttle Projects Value Engineering (SPVE) initiative. This involves our in-house design team undertaking a full review of the client's design proposals. This is carried out immediately upon contract award, and seeks to identify any design errors, any conflicts in the specified information and makes recommendations for improvement opportunities.

At Langport, deficiencies in the permanent works design were highlighted, as no provision had been made to retain the embankment at the intersection with the existing River Parrett viaduct structure, risking potential slope instability in this location. Having completed our design review so early in the project lifecycle, we were able to raise this issue with the client's designer, agree a solution, and install the corrective measures without consequence to the project programme.

As often can be the case, the designed piles reached practical refusal in several locations. This occurs when hard strata is encountered at a shallower depth than the permanent design had anticipated. We responded proactively and efficiently by providing the designers with the necessary driving record information at the earliest opportunity, allowing them to

confirm whether the pile had reached acceptable design levels, and minimising any risk to programme.

Protecting our Ecology

It was identified during the pre-tender period that badger setts were located within the embankment site. We engaged an experienced ecologist to provide specialist guidance to ensure that we properly cared for these animals, creating their new homes with artificial badger sets. Exclusion zones were established and we closely monitored the successful transfer of badgers to their new setts prior to work resuming in each area. Programme and methodology adjustments were made to minimise the impact to the badgers.

Putting the Community First

Given the substantial nature and volume of materials demanded by the project, residents were naturally concerned about the potential impact from high numbers of lorry movements, and the safety and wellbeing of their community. To address these concerns and reassure the residents that we were taking every possible step to minimise the impact, several measures were taken:

- We engaged closely with our haulage providers to create a "Virtual Fence" around Langport which registered all lorries entering and leaving the village through a GPS tracking system. This was used to monitor and control the speed of heavy goods vehicles, ensured driver accountability, and minimised noise and air pollution.

- The logistical challenge of transporting the 23m long sheet piles through the narrow streets of the village was meticulously planned using computer aided "swept path analysis" and subsequently proven with a full-scale trial delivery. This attention to detail gave us absolute certainty that deliveries would not be obstructed or cause damage to any property or public spaces within the village or cause unnecessary inconvenience to local residents.
- To achieve the most sustainable solution and maximise the social value contribution from the project, imported aggregates were sourced from local quarries with the capacity to supply 90,000 tonnes of materials to meet the project timescales.
- On the eastern side of the site, the piling plant working platforms were situated very close to resident's homes. To reduce encroachment to their property and mitigate disruption, we devised temporary sheet pile retaining structures to avoid using a battered working platform. We also provided acoustic barriers and bunds to further minimise noise disturbance as much as practically possible.

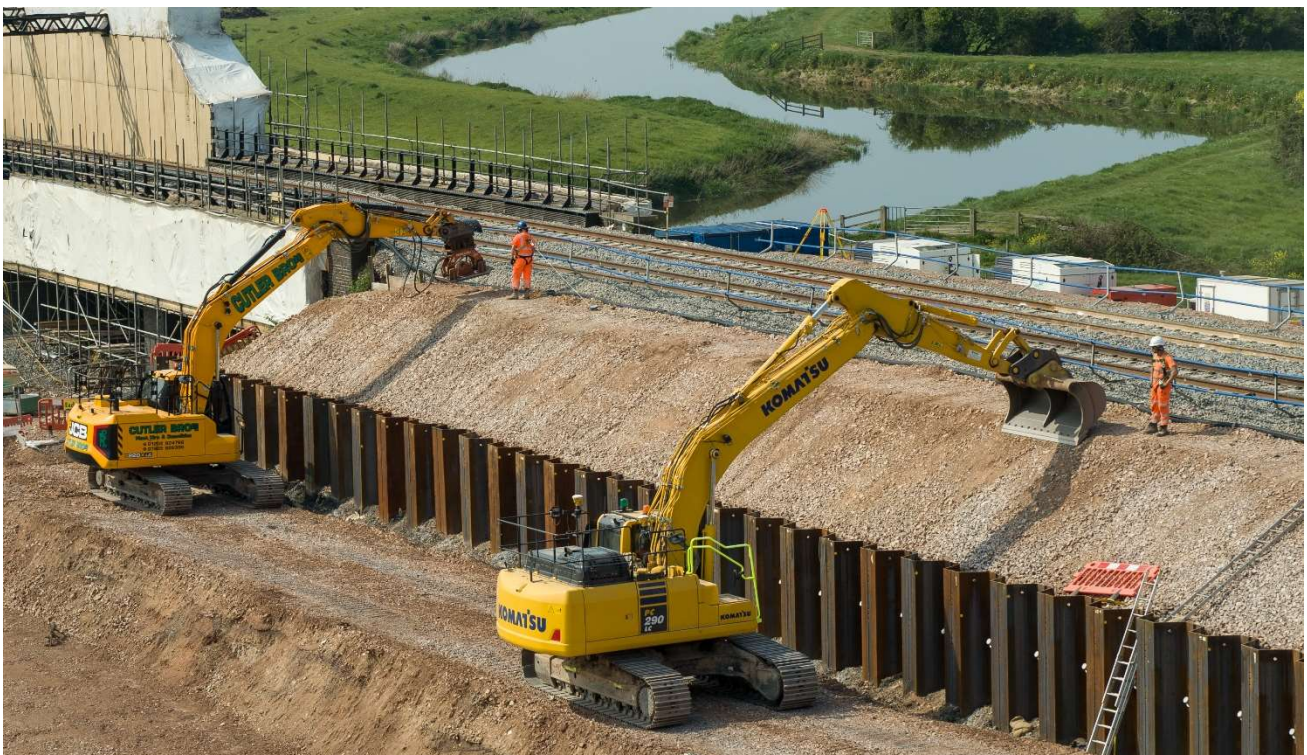
During the project we held community engagement events with Huish Episcopi Parish Council and Langport Town Council. We used these engagements to inform residents of the work taking place and to respond to any questions. We also attended Huish Episcopi Primary School, holding talks with their students to emphasise the many potential hazards and the importance of health and safety on construction sites.

Outcome

As a result of our proactive and creative approach at Langport Embankment, we received Network Rail's Safety and Sustainable Development 3 Star Award, a national recognition and only the second time it had been awarded within the Wales and Western Region.

Creativity

The creative approach developed for stabilising the Langport Embankment resulted in significant cost and programme savings. Our developed solution proved to be such an innovative, efficient and safe methodology, that it was subsequently adopted widely across the railway network to maximise industry productivity whilst trains are running.





Productivity

Through our ongoing investment in research and development, we identified new piling technology which when introduced into the project, resulted in significant time and cost savings by avoiding the importation of 10,000 tonnes of granular material; hence minimising carbon emissions, along with disruption to the local communities and highways network.

Reliability

Upon contract award our in-house design team undertook a full review of the client's design proposals. We identified potential issues that could then be proactively and collaboratively resolved before they could impact outturn costs and programme delays. When it was identified that existing powerlines were lower than specified, we devised a new design and methodology solution that was accepted without revision, and the potential programme delay was averted.

Sustainability

Less than 0.4% of the project's waste went to landfill, through our careful and proactive management in the importation and sustainable disposal of 90,000 tonnes of temporary works material.

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Simplifying Projects

Better more reliable outcomes

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