Asher Thomas
EngTech MICE

This paper achieved **2nd place** in the PWI Young Achiever Awards

TRANSPENNINE ROUTE UPGRADE PROJECT E234

Asher Thomas is currently a Senior Project Engineer on the TransPennine route upgrade. Asher joined Network Rail on the graduate scheme in 2017, and since then has had experience in track maintenance, asset management and most recently major enhancements.

Asher's background is in civil engineering but today his role includes being responsible for all the technical assurance of his project area, managing design integration against programme and budget as well as project requirements and safety legislation.

Asher describes himself as a passionate young engineer who loves a challenge, and he appreciates the support which the PWI continues to provide him through his professional career and development.

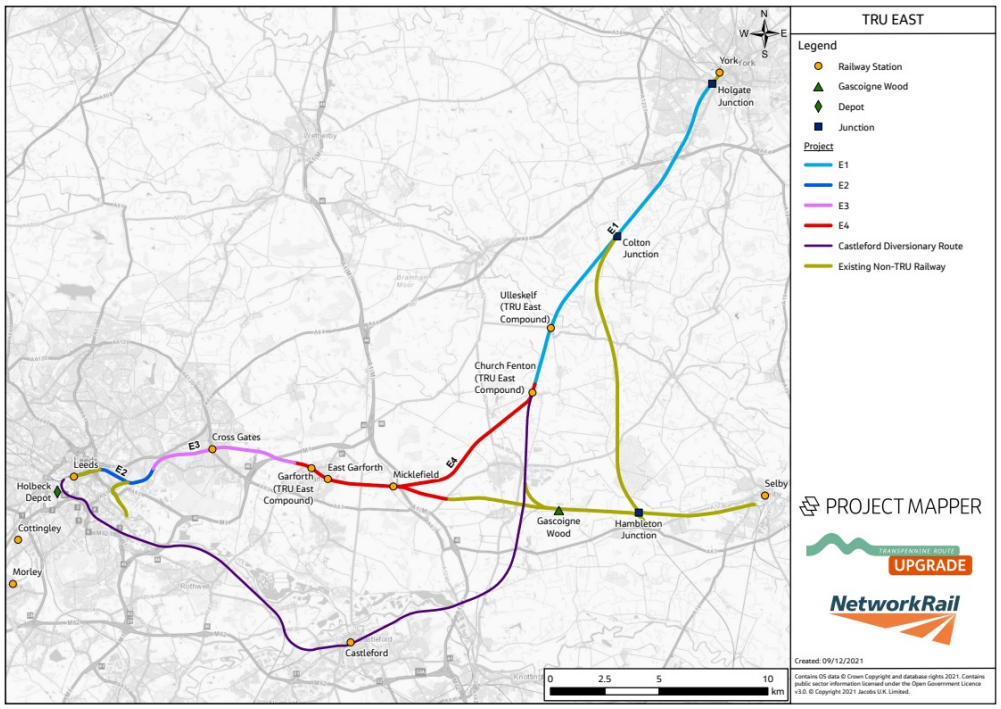

Figure 1: Map of Trans Pennine Route Upgrade East

INTRODUCTION

This report highlights my role in the completion of the project stage GRIP4 or "Approval In Principle (AIP) / outline design" for Area E234 (Leeds to Church Fenton), on the Trans Pennine Route Upgrade (TRU), **(see Figure 1).** The Network Rail (NR) route milestone and project Key Performance Indicator (KPI) for completion of AIP was October 2022.

My Project Area, E234, covers approximately £1.1bn of enhancements, and in my role as Designated Project Engineer (DPE) for infrastructure under NR/L2/RSE/02009 - Engineering Management for Projects, I am responsible for the technical acceptance of all aspects relating to: Structures, Lineside Civils, Stations, Track, Geotechnics, Drainage, OLE, highways and their interfaces with systems elements such as telecoms, signalling, LV/signalling power, HV and SCADA.

I am also responsible for various systems elements including requirements management, operations and maintenance, CSM and interoperability legislation and performance, reliability, availability and maintainability modelling (PRAMs).

PROJECT BACKGROUND

NR is transforming the TransPennine main line to bring passengers more frequent, faster, greener trains, running on a better, cleaner and more reliable railway. While some elements of the programme are still being designed and developed the major programme of work continues, to bring better journeys for passengers across the Pennines and beyond.

This will provide an improvement in journey times between key stations so that passengers can travel to their favourite towns and cities more quickly. The fastest journey times are forecast to be 63-66 minutes between Manchester and York and 41-42 minutes between Manchester and Leeds.

NR is electrifying the whole route to enable greener trains to run, reducing carbon footprint and improving air quality. The plans aim to save up to 87,000 tonnes of carbon emissions each year – supporting the government's Net Zero objectives. NR is also developing a proposal to move more goods by rail (up to 15 more freight trains each day) which is expected to remove over 1,000 lorries off the road each day.

The above project objectives are proposed to be achieved through the delivery of the following summary scope -

- Through alignment design (TAD) of the track in various areas.
- Linespeed improvements where identified.
- Track renewals where identified, with the Route Asset Manager.
- Resignalling of most of the route, including provision of bi-directional signalling where applicable and replacement of Marsh Lane and Neville Hill with new Computer-Based Interlockings (CBIs), as well as replacement of Church Fenton and Peckfield interlockings with new CBIs.
- Junction and driver's walkway lighting.
- Electrification of the route, interfacing existing systems in the E2 area where applicable.
- Provision of Supervisory Control And Data Acquisition (SCADA), for

the route's electric traction systems.

- Renewal of telecoms equipment with Fixed Telecommunications Network (FTN) uplifted to FTNx (an upgraded configuration of FTN), in identified areas, and GSM-R upgrades to provide capacity for digital ready.
- Earthwork interventions to accommodate new lineside infrastructure where required.
- Boundary fences and road vehicle incursion (RVI) to be risk assessed.
- Structures work to accommodate increased tonnage and electrification on underline, overline and culvert structures, including providing adequate parapet heights.
- Closure of 6 no. Level Crossings on the Leeds Lines.

For all of these I have managed a team of 20 Engineers who reviewed 120+ Design packages for technical assurance. A further breakdown of the works is shown in **Table 1**.

Railway Subsystems – Approximate Asset Change				
Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
Systems	Signalling	Multiple aspect	Signals	99 new signals (New Dorman Integrated Lightweight Signals or Colour Light Signals) 7 amended signals 17 existing signals
				Position light signals will be LED types.
		Point Equipment		New point operating equipment will be In Bearer Clamp Locks on CEN56 rail or Hy-drive points on NR60 rail
		Train detection		Track circuits – Mostly removed some Medium Voltage DC circuits remain.
				Frauscher axle counters will be the predominant method of train detection in the new interlocking areas.
		Lock Out Devices		14 lockout systems (areas) consisting of 2-4 lockout devices each.
		Interlocking		Recovery of 4x Route Relay Interlocking (Marsh Lane, Neville Hill, Peckfield and Church Fenton) replaced with 2xCBI
		ApCo		2x New Automatic Power Changeover locations at Micklefield Jcn and Church Fenton.
		Level crossings	Level Crossings	6x Level Crossings to be permanently closed on core route. 2x Existing level crossings (Normanton and Colton Junction Line) affected and assessed, plus 3no. on the HUL3 fringe.
	Telecoms	Line side telephone system	SPTs, Point Zone Telephones Lockout Device telephones, Ground Frame Telephones and Level Crossing Telephones	20x retained Signal Post Telephones (SPTs) 2x relocated SPTs New lineside telephony to suit new signalling assets
		Radio systems	GSM-R In Fill	5x GSM-R Infill Sites
			Access Nodes	18 GSM-R/FTN Access Nodes
			Proposed Telecoms works at Signal Boxes/Relay Rooms/ Relocatable Equipment Buildings and Network Termination Points	18x Locations to be upgraded.
Systems	Electrification	Contact systems	25kV OLE DC systems	Approx 20km of New UK Master Series 125 OLE Approx. 800-1000 OLE Structures
		Distribution systems	Track Sectioning Cabins (TSC)	1x New Church Fenton TSC 1x Neville Hill TSC 1x Micklefield Mid-Point TSC
		Plant	Points heating	7x New/Modified Points Heating Control Cubicles
			Junction Lighting	7x New locations for Junction/Footbridge Lighting

Table 1: Breakdown of proposed works

Railway Subsystems – Approximate Asset Change				
Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
Infrastructure	Track	Plain line		Tamp to Through Alignment Design (TAD) 1654m Re-rail, Re-Sleeper, Reballast 18120m Formation Renewal, Reballast, Re-Sleeper & Re-rail 1000m Re-rail only 15942m
		Switches & crossings		32x New S&C Units in E2 1x Crossover at Cross Gates Renewed connection to Down Normanton Line at Church Fenton South Jcn
		Line Speed Improvements		Up to 75mph in E2 Up to 100mph in E3 Up to 90mph in E4
		Track Category		Track category increase (mainly from CAT 2 to 1)
Infrastructure	Civils	Line side fencing		Approx 1700m of new or replaced boundary fencing
		Track access point		6x new pedestrian access points 1x Level Crossing conversion to Road Rail Access Point
		Location Cases (LOCs)		Approx 75x New LOCs (signalling/LV/Telecoms)
Infrastructure	Bridges	Over line bridges Under line bridges Footbridges Culverts Other		1x New Footbridge 1x New Equestrian Footbridge 1x New Road Overbridge 7x Bridge Reconstructions (with 1 more in optioneering) 1x Partial Reconstruction 1x Footbridge Removal 3x Footbridge replacement 10x Arch/Underbridge Condition Based Repairs 21x OLE Warning Signs to be installed on structures 6x Culverts Relined and 2x Culverts Extended and 1x Culvert Partial Removal 56x existing structures reviewed with no Intervention Required
	Retaining walls	Retaining Walls		Approx 3200m of new retaining walls
	Under track crossings (UTX)	Under Track Crossings (UTXs) and Under Road Crossings (URXs)		E2 6no. UTX's and 2no. URX's E3 1no. UTX E4 3no. UTX's HUL3 Fringe 1no. UTX NOC Fringe 1no. UTX and 1no. URX
	Equipment support structures	Signalling		4x New Fixed Posts 63x New Fold Down Posts 16 (signals on) New Gantries 11x Short Posts & 1x Wall Mounted
		Traction power (OLE)		
	Drainage	Surface water Foul water		E2 - Approximate total 5,224m of new track drainage E3 - Approximate total 2,867m of new track drainage E4 - Approximate total 6,060m of new track drainage

Table 1 (cont): Breakdown of proposed works

KEY CHALLENGES:

Rose Lane flood alleviation structure, part of a Transport & Works Act Order (TWAO)

Part of the project proposals includes the closure of the vehicular level crossing which accesses several houses in the triangle of land just south of Church Fenton station. Due to the requirement for maintaining access to these houses a new overbridge and approach embankments were designed, with land acquisition attained through a TWAO process. As part of the flood analysis for the TWAO it was found the earthworks embankments proposed as part of the design caused a redirection of flood waters towards the houses in an extreme weather event. It was deemed this would be unacceptable to the Environment Agency, and a new design had to be created.

Figure 2: Artist's impression of the new road and bridge

After reviewing the various options, it was determined that a 3-span metallic viaduct allowed the appropriate throughput of water under the structure to mitigate the rise in flood waters at the houses in an extreme weather event. **(Figure 2)**.

My involvement in this was providing technical assurance against both AiP designs, reviewing flood modelling data, engaging with key stakeholders such as the asset management team at NR and supporting the optioneering for an alternative solution which included reviewing box culverts and property level protection.

Reconstruction of three Listed overbridges with consents from Historic England and Leeds City Council.

Due to a lack of space for an electrified railway with passive provision for 4-tracking in some locations we have to reconstruct 3x Listed overbridges and demolish another. Getting consent from Historic England was a collaborative approach. By creating a bespoke jacking solution for a cast iron arch structure and providing a bridge silhouette mimicking the historic masonry arch bridges, (albeit in weathered steel), we were able to gain agreement for their reconstruction and the demolition of another historic masonry arch overbridge. **(Figure 3** and **Figure 4)**.

Figure 3: Bespoke Jacking of HUL4/20

Figure 4: Visualisation for Historic England

Equally, we approached Leeds City Council (LCC) for their input into the highway design, where they noted their aspirations for two traffic lanes where there is presently a single bi-directional carriageway. By progressive design iterations and early engagement with LCC we were able to compromise on carriage and footpath widths to get two lanes on the existing bridge abutments.

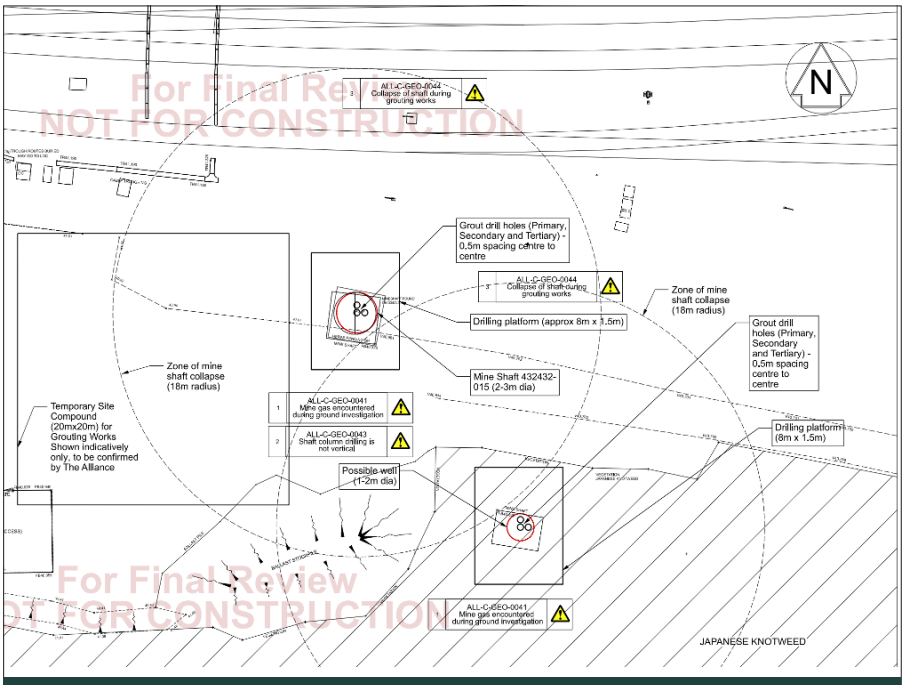

Figure 5: Extract of drawing showing historic mine workings and proposed mitigation works

Existing Mine workings impact on foundations for OLE and Bridge reconstructions, including grouting and capping of the mineshaft.

Under different areas of the rail footprint through the journey between Church Fenton and Leeds there are areas of known mine workings, of which the extent is not understood. These risk collapsing mine works due to our pile foundations or increased load on bridge abutments. We also had a loose filled mineshaft that is directly underneath the new track position, with the opening buried 4m below ground level. This required a coal authority agreement and specialist grouting contractors with a detailed methodology with various actions based on conditions found. **(Figure 5)**.

Figure 6: View of Richmond Hill cutting and Neville Hill Depot

A 12-week blockade through Richmond Hill cutting and Neville Hill Depot

The project scope required full renewal of the track system through Richmond Hill cutting (**Figure 6** shown in left of photo) and the core route through the depot. A high level summary is shown in **Table 2**.

Cat 11 renewal (rail, ballast, sleepers, formation) throughout
Renewal of point ends & crossovers totalling 32 S&C units.
Installation of reception road, triple sidings (significant elevation difference to main tracks with a retaining wall), buffer stops & derailment protection
All associated drainage works (~4500m)
Removing of existing stabling sidings & Tie in with the existing depot
New NR60 Mk2 S&C design. The TRU is installing the biggest batch of new technology NR60 Mark 2 S&C equipment in one go to date.

Table 2: Summary of works in Richmond Cutting and Neville Hill Depot

INNOVATION:

Innovation is ingrained in my day-to-day working, I champion innovation in my project and have gained recognition as leading the process. **(Figure 7)**.

FRP footbridges being installed.

My project proposes to install two new Fibre Reinforced Polymer (FRP) footbridges.

The structural form is a Warren truss, modified with vertical elements. The bridge has a traditional form of construction, and would be unremarkable were it not for the use of FRP and the novel form of connection between the diagonal members and the top and bottom booms.

The top and bottom booms and the truss diagonals are Square Hollow Section (SHS) box sections; the cross girders are 'I' sections;

Rob,

Following up on my e-mail yesterday about TRU innovation, I wanted to let you know that there was a lot of praise for Asher Thomas for really going the extra mile in assisting with new innovative ideas and products. I'm told, Asher will lead discussions with the design team and NR to proactively find parts of the project to either trial the innovation or simply go straight into using it. This approach has let to quite a lot of good work where new products are getting used bypassing the outdated and laborious process that they usually would take. Which feels like some of the best SPEED approach.

The basic gist was could we clone him.

Thanks

Department for Transport

Figure 7: Commendation from DfT representative

Figure 8: Partially Completed Test Footbridge at Rail Live 2021

Figure 11: Recoverable pathway

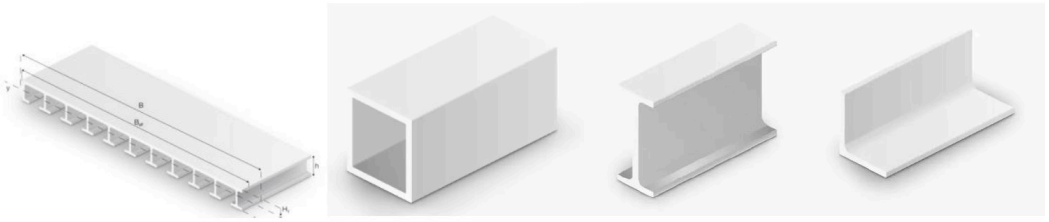

Figure 9: Typical Sections

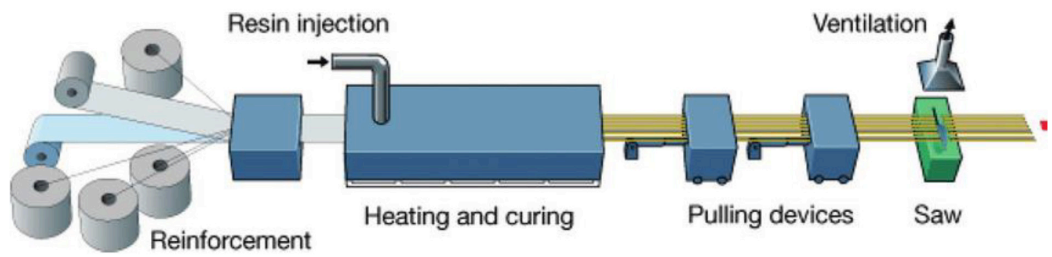

Figure 10: The Pultrusion Process

the verticals are flat plates and angle sections, and the deck is a rib stiffened decking plate. **(Figure 9)**.

All components are supplied by Fiberline, an experienced supplier of FRP sections, located in Denmark.

The sections are pultruded in a process which involves drawing fibre through a heated die. While passing through the die, resin is injected and a constant pressure is applied, resulting in the resin melting and its impregnation into the fibrous reinforcement. The pultruded sections are then sawn into lengths. **(Figure 10)**.

The truss has a novel joint detail which connects the truss diagonals to the booms. However, I am unable to provide details due to NDA requirements for intellectual property.

Temporary / recoverable assets for digital readiness

As part of the future of the rail industry and ETCS we need to start thinking about how to transition to a digital railway. NR has a design standard NR/L2/Sig/11711 - Digital Railway Ready Signalling, for a digital ready signalling renewal. However, digital readiness goes beyond this. It includes thinking about design life and construction with recovery in mind.

Examples on our project include using screw piles for signal foundations that can be removed / reused elsewhere, using temporary asset policies for cable troughing to negate the provision of 'future space capacity' for cables that will be coming out/not staying in, and removable cess pathways rather than traditional stone and timber edging paths. **(Figure 11)**.

My time on TRU has given me a breadth of experience across all technical disciplines. This has really helped my understanding of systems approach thinking which will help me in the future. Whilst I was thrown in the deep end as my first DPE appointment I have been given all the tools to develop and have a supporting team of experienced colleagues in our business alliance to keep me on track.

Some key learning that I have taken from the project includes the time it takes to get innovations into such a strict legislative environment, and that with such a large programme of works there is a need to be agile as there is so much opportunity for change, both internal and external, to have an influence. Trying to keep track of the latest developments and pick out which changes can result in safety critical decisions continues to be a real test of my engineering judgement.

Next time, I think I will be more challenging on scope and deliverables early in the project life cycle, rather than managing late change from value engineering at a time where programme delivery needs to be locked down.

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TECHNICAL ARTICLE

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