THAMESLINK PROGRAMME

Sustainability Best Practice Case Study

Control of Noise and Vibration during Construction and Operation of the Thameslink Programme

Twenty-two million people live within 500 metres of our network of which 5 million either back onto or face the railway. Improving our network through delivering major Infrastructure Programmes such as the Thameslink Programme (TLP) will enviably generate noise and vibration. However, if we do not manage these impacts appropriately not only do we have a negative impact on our neighbours but it can also adversely affect our ability to deliver our works, our business and our reputation.

On the TLP construction and operational noise and vibration is our most significant socio-environmental impact therefore as part of our vision to deliver a sustainable programme we committed to implement robust controls to keep these impacts to a minimum.

On TLP we have tackled the complexity of delivering major construction works in densely populated areas of London such as Blackfriars, Farringdon and London Bridge and introduced more trains to our network, whilst keeping our communities impacts to a minimum. This case study summaries how the TLP achieved this.

Location of sensitive receptors at London Bridge

The impacts and effects of Thameslink

The enhancements being implemented by the TLP will serve to increase the capacity of the railway across the whole of the existing Thameslink network, and in particular the route through Central London. Given the nature and location of the scheme it is inevitable that some sensitive receptors will be subject to the impacts and effects of noise and vibration. The control of noise and vibration during both the construction and operation of the railway has therefore been one of the key challenges in delivering the scheme.

Approach to the management of noise and vibration

During the early stages of the TLP, the potential impacts and effects of noise and vibration were considered within the Environmental Impact Assessment (EIA) as part of the planning process. The purpose of the EIA was to aid planning decisions by identifying and assessing the likely significant environmental effects of a scheme and describing the measures to avoid reduce or is possible remedy significant adverse effects. For railway schemes, noise and vibration is often one of the most significant socio-environmental impacts. The EIA was an essential component of the evidence necessary for Network Rail to secure powers for the scheme, which were subsequently granted as the Network Rail (Thameslink 2000) Order, 2006.

As an output of the EIA a comprehensive set of project specific policies, procedures and systems were developed to mitigate impacts during both the construction and operation of the scheme. The TLP Noise and Vibration Policy sets out the broad approach adopted, with the underlying principle being to avoid significant

adverse effects of noise and vibration arising from either construction or operation of the scheme, wherever and whenever reasonably practicable. Control measures were then developed in accordance with a defined mitigation hierarchy.

The TLP Noise and Vibration policies and controls were embedded into TLP's IS014001 Environmental Management System (EMS). As part of our EMS TLP were able to successfully manage its noise and vibration risks through the following;

- **Impacts Register** - Identifying noise as a key impact for the TLP in our Environmental Impacts Register.
- **Inductions and Toolbox Talks -** Our new starter's induction programme included a Consents, Sustainability and Property induction which highlighted noise and vibration as a key impact from the TLP and the importance of managing this risk in design and construction works. For our work sites noise and vibration risks were regularly briefed to site staff via toolbox talks
- **Design and construction** - Noise and vibration mitigation were embedded in our design and construction process in line with our policies, procedures and best practice guidance.
- **Control Plans** - Noise and Vibration Management Plans were established as part of our GRIP process.
- **Section 61's** – All our works required a section 61 which was prepared by our suppliers and reviewed by our Noise and Vibration Specialist.
- **Notifications** – clear, concise and advanced notification of our works with our neighbours. Where different suppliers were working in the same location the suppliers and communications teams worked together to develop and co-ordinate a joint notification.
- **Noise and vibration inspections** - were undertaken by our supply chain and Consents and Sustainability Team.
- **Audits** – Noise and vibration audits regularly featured in our TLP annual audit plans.
- **Incidents and Complaints** – All incidents were investigated according to our incident procedure and corrective measures put in place. Any significant incidents were communicated across the TLP via our health and safety cascade. Our complaints were managed swiftly by our suppliers, NR Consents and Sustainability teams and NR Communications Teams in accordance with our complaints procedure.
- **Performance** – Our performance in relation to noise and vibration was formally reviewed every 6 months with our TLP Executive as part of our ISO14001 Management Review. All best practice and lessons learnt were shared with the TLP and our supply chain.
- **Resources** – the TLP had a dedicated Noise and Vibration Specialist who provide technical expertise and guidance across the programme and supply chain. For our London Bridge Station Redevelopment project the TLP paid the local authority to have an Environmental Health Officer to review our section 61 consent applications.

On TLP our highest type of environmental incidents and complaints related to noise. For example at London Bridge between 2012 and 2018 60-78% of environmental complaints and 38% of environmental incidents were noise related.

TLP has a target to reduce noise and vibration complaints year on year. We achieved this with a 25% decrease in noise complaints, which is a significant achievement in light of the major construction works at London Bridge. We also decreased our environmental incidents year on year while increasing our environmental close calls demonstrating a positive shift in environmental management on site.

Operational noise and vibration

Noise and vibration impacts arising from the operation of the Thameslink scheme are those associated with the train movements themselves and the ancillary systems, such as station public address/voice alarm and power supply infrastructure. The Environmental Statement 2004 set out the generic measures to be adopted to mitigate the impacts and effects of train movements, as follows:

Rolling noise broadband noise (i.e. across all frequencies), emitted by the wheels, rails and sleepers arising due to the interaction between wheel and rail. Control measures include removal of rail joints, use of damped rails and optimum selection of under-rail pads, use of noise barriers and adoption of an appropriate maintenance regime (including rail grinding in order to maintain a smooth surface and minimise contact forces).

Structure-radiated noise or groundborne noise and vibration a low frequency rumble resulting from the transmission of vibration to the structure of the bridge or viaduct or from sub-surface running tunnels. Bridge noise from steel structures tends to be a significant component of the total railway noise in the vicinity of such structures, whilst masonry or concrete structures do not significantly increase the total railway noise level above that normally associated with rolling noise. Mitigation measures include the use of resilient track forms, such as soft rail pads, sub-ballast mats, under-sleeper pads, booted sleepers or resilient baseplates, as appropriate.

Curving noise or 'wheel squeal' high frequency noise which can occur in tight radius curves, generated either by contact of the wheel flange with the side of the rail and check rail, or by unstable friction characteristics between the top of the rail and the wheel. Mitigation measures include changes to the track geometry, appropriate lubrication to the side of the rail and application of a friction modifier to the railhead.

Extensive, detailed acoustic modelling has been undertaken throughout the design development process in order to optimise the various mitigation measures and avoid significant adverse effects, where reasonably practicable. Such design development has led to the incorporation of various novel and new forms of mitigation, including under sleeper pads and booted sleepers on both plain line and through switches and crossings (S&C), resilient baseplates, rail dampers and rail head friction modifier, some of which have rarely or never previously been used on the UK rail network. In so doing, it has been necessary for the Thameslink Project to both prove the products and obtain acceptance for use on the railway infrastructure.

Within the core area of the Thameslink route the following noise and vibration control measures have therefore been introduced:

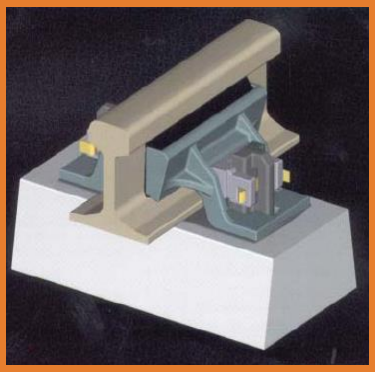
Canal Tunnels: Sonneville LVT HA booted sleepers for new slab track on both plain line and S&C over a distance of approximately 900m of twin track railway.

Kings Cross Tunnels: Pandrol Vanguard resilient baseplates retrofitted to slab track over a distance of approximately 250m of twin track railway.

Noise mitigation measures

Tata SilenTrack rail dampers being installed at Blackfriars

Acoustic barriers at Station Approach, London Bridge



Pandrol Vanguard resilient baseplate

Blackfriars: Getzner under sleeper pads (for both plain line and S&C), soft 'Type A' rail pads and Tata SilenTrack rail dampers over a total length of approximately 1300m.

Borough: Getzner under sleeper pads (for both plain line and S&C), soft 'Type A' rail pads and Tata SilenTrack rail dampers over a distance of approximately 350m of twin track railway. In addition, 2.2m high sound absorbing acoustic barriers have been introduced across the 350m length of the new viaducts.

London Bridge Station: Getzner sub-ballast mat through each of the new in-station platforms and Station Approach Viaduct, over a total length of approximately 1500m.

In addition to the foregoing, lubrication and friction modifier has been introduced over much of the core area between Canal Tunnels, Blackfriars and London Bridge in order to mitigate squeal noise. Where track has been renewed or remodelled by the Thameslink Programme efforts have also been made, where reasonably

practicable, to reduce joint noise. This has been achieved by the use of continuously welded rail or use of longer rail lengths, minimising S&C and welding of joints.

Maintenance

Having designed and installed the new infrastructure, it is also necessary to maintain the railway and rolling stock in such a manner as to prevent significant increases in noise due to deterioration in the condition of rail. Through certain sections of the core London area the increase in train service associated with the Thameslink Programme gives rise to a doubling or tripling of tonnage (volume of traffic). Such an increase, exacerbated by steep gradients, tight curvature, frequent station stops and the use of Automatic Train Operation (ATO), could potentially give rise to rapid and significant rail wear and rail corrugation, leading to higher noise levels.

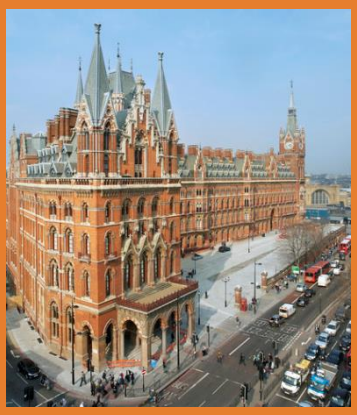
Measures have therefore been put in place to reduce rail wear and maintain the track in an appropriate condition, including:

- Use of harder rail, with increased resistance to wear (Tata HPrail)
- Use of friction modifiers
- An increased number of lubricators
- An enhanced rail grinding regime (6-monthly grinding)

Policies relating to the control of noise from fixed mechanical or electrical plant (such as transformer stations, ventilation and cooling plant, pumps, carriage washes etc.) and public address system have been developed in conjunction with key local authorities. The implementation of these policies by our designers and contractors means that we can be sure that an appropriate level of protection has been afforded to our neighbours at the lineside and in the vicinity of our stations and depots.

Case Study - Kings Cross Tunnels

Thameslink train services pass through the Kings Cross tunnels with the iconic, grade I listed St Pancras Chambers being situated directly above, which, after being derelict for a number of years, has recently been returned to its former use as a luxury hotel and residential accommodation. The tunnels were originally bored directly through the building foundations, with subsequent track alterations exacerbating the problem and giving rise to groundborne noise levels in excess of 55 dBA within the premises. Such noise levels are incompatible with the sensitive nature of a hotel and consequently, through the TWA Order process, Network Rail made commitments to reduce the noise to acceptable levels.



St Pancras Chambers

Extensive design development work (noise modelling, performance and constructability trials) was undertaken to determine the optimum solution, taking into consideration the significant constraints, including limited track access and height restrictions. The chosen solution was a Pandrol Vanguard resilient baseplate, which was anticipated to reduce the noise levels by 10-15 dB. Following installation in 2010-11, monitoring was carried out over an 18 month period to determine the effectiveness of the mitigation. Results of the monitoring indicate that the combined benefit of the resilient baseplate and re-railing with micro-head hardened rail reduced the average train noise level by 19 dB, approximately 13dB of which is considered to be due to the baseplate. In addition, it was found that the new track system had eliminated rail corrugation over the 18 month monitoring period.

Construction noise and vibration

The construction and engineering works associated with delivery of the Thameslink Programme often involve large complex sites or rail renewals in densely populated areas. Due to their proximity to the operational railway many of these works need to take place during the night time or at other sensitive periods. It has therefore been necessary for Network Rail, its designers and contractors to develop designs and construction methods which minimise any potential adverse impacts and effects in accordance with the principles of Best Practicable Means (BPM). A guidance note on the implementation of BPM for construction works was therefore developed in consultation with key local authorities.

A further measure implemented in order to minimise the impacts of construction has required all Contractors delivering significant works to obtain prior consent from local authorities under section 61 of the Control of Pollution at Work Act (CoPA) 1980. In doing so, the Contractor must demonstrate to the local authority that the proposed working methods and controls are in accordance with the principles of BPM and that a nuisance would not arise from those works. By obtaining prior consent for construction works – and adhering to the terms of that consent - the contractor is provided with a defence against any enforcement action under s60 of CoPA or s80 of the Environmental Protection Act, 1990, thereby mitigating risks to programme and cost.

Inevitably, this process requires extensive liaison with local authorities and we have sought to encourage an open and collaborative approach. Similarly, we have sought to engage with other stakeholders and lineside neighbours, whether through stakeholder meetings, community forums or providing advance notification of works.

In situations where, despite implementation of BPM, it has not been possible to avoid significant effects of construction noise, the Thameslink Programme has implemented a policy for the provision of noise insulation or temporary re-housing, subject to the application of certain criteria.

Best Practice – London Bridge

In the summer of 2016 London Bridge entered into a stage of the programme where substantial demolition works were undertaken directly adjacent to neighbouring residents. The works included taking possession of platforms, demolishing station arches, old platforms and canopies and removing running rails and ballast and rebuilding the new concourse bridge platform structures and track. Due to the requirement to keep the station open throughout the works and the nature of a live railway site, a certain amount of 24/7 working was required.

Given the extremely close proximity of the works to sensitive receptors (<10m) and the programme and costs constraints of shutting an operational railway line and part of the station for 7 months there was concern this could result in significant legal, financial and reputational costs. A different approach to noise management was therefore implemented which was based around a sustained, smart and enhanced employment of BPM to ensure project success. This included;

Temporary rehousing and noise insulation – 2 temporary rehousing periods were implemented for defined stages of the works were excessive noise would be experienced. A noise insulation package of secondary glazing and ventilation was also offered and installed to qualifying properties.

Implementation of BPM – such as the temporary erection of an acoustic barrier at strategic locations, widespread use of prefabricated materials to reduce noisy in-situ works, tackling the noise at source, using quieter plant and techniques and the use of acoustic enclosures for specific activities.

Benefits of approach to noise and vibration

- ✓ Noise and vibration was a key consideration in obtaining powers under the TWA Order
- ✓ Helps to achieve compliance with commitments and undertakings to third parties and compliance to ISO14001
- ✓ Reduces the impacts on lineside neighbours
- ✓ Provides a proactive management tool
- ✓ Provides a defence against enforcement action, minimising risks to construction programme and cost
- ✓ Manages and enhances public and stakeholder relations

With thanks and further information

For further information on the Thameslink programme please see below;

Thameslink Programme
http://www.thameslinkprogramme.co.uk/
Thameslink Sustainable Development Policy
http://www.thameslinkprogramme.co.uk/approach

London Bridge Beat Practice continued…

Employment of a night shift noise and nuisance officer – who was responsible for ensuring s61 consent compliance, site noise monitoring and the implementation of BPM on nights to minimise disruption to residents. The residents could contact the officer directly so complaints could be dealt with immediately. This role also provided assurance of noise predictions and reassurance to Southwark Council.

Noise monitoring – a network of real time noise monitors were installed around the site including 3 vibration monitors. Attended monitoring was also undertaken by the Noise and Nuisance Officer.

Detailed planning of the works – all works were extensively planned with particular focus on mitigation of noisy activities, targeted night time restrictions on noisy activities near residents whilst allowing 24hr working for other activities and justification of works opposite residents.

Engagement – extensive and sustained stakeholder engagement both internally and externally. Monthly residents meetings and individual's visits by the sustainability teams to ensure residents' concerns were taken into consideration.

Co-ordinated and timely notifications – all residents were notified in advance of works through the London Bridge newsletter. To prevent duplicate notifications from the Balfour Beatty (BBR) Track team working in the London Bridge area at the same time the BBR and Costain teams worked together to agree and issue joint notifications.

Change in culture – development of a 'noise aware' culture on site which included regular noise specific briefings to site management and operatives

Successes

The project has been able to work 24/7 365 days a year without significant noise impacts to the surrounding community.

The project won the Noise Abatement Society's John Connell Award (The Noise Oscar) for implementing a range of initiatives to reduce noise from its work for the benefit of the environment and community.