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### Why are S&C layouts failing?

Source: RTM Apr/May 17

*Dr Sin Sin Hsu, programme engineering manager IP Track Development at Network Rail, analyses why switch and crossing (S&C) layouts fail prematurely and how a Good Practice Guide to S&C design helps mitigate the risk.*

S&C performance in terms of reliability and asset life has deteriorated across the UK network in recent years. Delay minutes in 2014-15 for S&C failures causing disruption to traffic and customers cost Network Rail over £60m, not including maintenance costs. To some extent this is due to increases in tonnage and speed, and to newer, heavier rolling stock. However, there are more fundamental underlying issues with components and designs which manifest themselves primarily at the wheel-rail interface – where millimetres matter.

Standards provide safe limits for operation, but don't necessarily give guidance on good design of components or systems to achieve performance requirements and maximise service life.

An increasing number of new layouts are failing within months, or even weeks, of installation. New switches in the Reading remodelling are a case in point. Great West Junction (Basingstoke) was renewed in 2007, but ongoing speed restrictions due to geometry deterioration and component failure have plagued the layout ever since. Such failures are preventable.

#### What are the causes – and the solutions?

Analysis of defects in switches reveals that by far the most prevalent (over 3,000 per year) is switch blade damage, with an escalating trend over the past four years. Failures are also occurring at common and obtuse crossings, with a growing trend of foot cracking in cast crossings.

These trends need to be arrested and performance and reliability improved. To achieve this goal, it is necessary to identify root causes of failure modes and propose robust solutions.

Thorough site investigations and detailed analysis, using tools such as VAMPIRE and Track-Ex, demonstrated that the majority of failures could have been avoided through better layout and alignment design and component specification.

A series of case studies, all of which looked at critical design features at specific sites and the application of alternative design to mitigate the inherent problems, are documented in the S&C Track Design Good Practice Guide (free to download from the PWI website, or the Network Rail Standards website).

The Guide promotes techniques and evidence-based engineering by using a 'Red, Amber, Green design checklist' for designers and specifiers to improve safety and reliability, and therefore more sustainable S&C performance. Examples of proposed solutions are:

- Reducing lateral forces on switch rails by increasing the turnout radius
- Improving vehicle steering through S&C by increasing cant deficiency
- Prolonging component service life for traffic type and speed, e.g. high axle-loads, avoid using sharp-angled crossings in high-speed S&C
- Providing consistent track support under S&C – and adjoining plain line
- Designing out, or simplifying, high-maintenance S&C, e.g. double slips, two-levelling
- Minimising high-impact loading at crossings, by optimising wheel transfer
- Suitable switch profile and horizontal geometry: compatibility with wheel profiles
- Appreciating the importance of correct machining and assembly tolerances
- Appreciating that manufacturing limitations may necessitate a 'maintenance activity', e.g. grinding, at or shortly after layout installation

#### Shalford Junction: a case study

A one in six cast crossing in a new double junction at Shalford was being damaged, within months of installation. Poor wheel transfer resulted in significant impact loading, leading to nose damage, voiding and damage to the nose bearer, and loosening of rail fastenings.

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