SUMMARY

From an operational point of view a turnout can be seen as a capacity multiplier for the railway operator. From the view of mechanical properties of the track it is a discontinuity which influences maintenance efforts and thus lifecycle costs. Not only the arrangement, type and different lengths of bearers establish this discontinuity, but also the fact that as a common standard switch machines are mounted on bearers beside the track. These asymmetrical heavy masses cause vibrations when a train is overrunning and damage the ballast quite significantly over some years of operation. Additional maintenance efforts for open locking mechanisms affected by dirt as well as disassembling the rodding in the sleeper bays before every tamping operation increases the downtime of track which is causing more and more concerns \[3\] \[4\] \[5\]. There is an ongoing development to improve this situation. Solutions proposed are already standard at many railways over the globe \[1\] \[2\] and are becoming common in Australia as well. The development is described in stages where the final stage has a low height switch machine on top of the concrete bearer or on a hollow sleeper without hindrance for tamping activities and additional remote condition monitoring system for monitoring the turnout.

1. ELIMINATE OPEN LOCKING SYSTEMS

1.1 Problem

In general there are two proven principles to ensure that the switch and stock rail are secure in the dedicated position when a train is passing: External and internal locking. In case the infrastructure authority specifies external locking systems, solutions as claw and clamp locks are used since the last century. For the track conditions we have in Australia due to dust and dirt from transported goods such as coal and iron ore are causing issues for these open locking systems.

1.2 Solution

The transfer of open locking mechanisms with linear locking arrangements into sealed, dust and dirt resistant closed locking mechanisms with spherical locking arrangements is now a proven low maintenance solution since many years in Australia.

Figure 01 shows the locking principle of the fully sealed SPHEROLOCK, using locking wedges arranged in a circle around a bar which is acting as a cam.
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NEW GENERATION SWITCH MACHINES FOR AUSTRALIA

The first installation of SPHEROLOCK in Australia (Figure 02) was in 2002 on a heavy frequented coal line in Queensland. It can be seen that the sealed and encapsulated design has been a big success but still all gear including the rodding is located between the concrete bearers within the sleeper bay.

Even for arrangements with internal locking solutions the rodding between the bearers is a major challenge for the maintenance crews. These rodding’s has to be removed and re-installed for tamping which costs a lot of time and influences the life cycle costs in a very negative way.

2.2 Solution

The introduction of in-bearers [6] which are housing all operating gear such as rodding and locking is a big step forward in evolution to reduce maintenance costs. Figure 04 and 05 show such arrangements, with conventional switch machines beside the track.

It has to be mentioned that a thorough finite element analyses of stresses is a clear must in responsible engineering of these in-bearers. Even if double in-bearers are patented globally, copies of double in-bearer solutions, without adequate FEA are seen on track which are judged a safety risk.

Figure 02: First installation of SPHEROLOCK

2. ELIMINATE RODDING BETWEEN BEARERS

2.1 Problem

Figure 03: Common arrangement at Australian Railways

Figure 04: Urban railway - double in-bearer with encapsulated locking systems and switch machines beside the track

Figure 05: Iron ore railway - double in-bearer with encapsulated locking systems and switch machines beside the track
3. ELIMINATE DOUBLE IN-BEARERS

3.1 Problem

Double in-bearers solve the problem with the track to be able to tamped but are contributes to cost factor, a discontinuity in track and most importantly the switch machines beside the tracks are oscillating masses when a train passes and damaging the ballast over the time.

3.2 Solution

A single switch machine with reduced space requirements and thus needs only one single in-bearer is a further step in evolution to low life cycle costs. Additional lower masses closer to the rail avoid ballast crushing as with common arrangements. Figure 06 and 07 shows such an arrangement at a consciously selected turnout in an urban railway network.

4. ELIMINATE ALL IN-BEARERS

4.1 Problem

Despite the fact that in-bearers are providing sufficient bending resistance they have, compared to concrete sleepers, different elasticity properties as well as different friction conditions in connection with the ballast bed. Also the additional costs for in-bearers are contributing to the life cycle costs.

4.2 Solution

Transferring the switch machine from inside the in-bearer on top of the sleeper is the next and at the moment latest step of evolution. [7]. This is only possible if the height of the switch machine is sufficiently low enough as shown in Figures 07 and 08 which are examples from an iron ore line in the Pilbara.

Figure 06: Single in-bearer with switch machine

Figure 07: Switch device on top of an in-bearer at an urban railway

Figure 08: Switch device on top of concrete sleeper at an iron ore line

Figure 09: Swingnose Machine on top of concrete sleeper at an iron ore line
5. ELIMINATE SCHEDULED MAINTENANCE

5.1 Problem

Scheduled maintenance is very common at railways all over the world, and so also in Australia. Special conditions in Australia with locations far away from basic amenities contribute that this maintenance regime can have another high impact on life cycle costs.

5.2 Solution

Remote condition monitoring of switch machines allows monitoring of the behaviour of the whole turnout system. Trend recording, monitoring, failure prediction and pre-warning are a major contribution to reduce operating costs, in comparison to scheduled maintenance (see Figure 10) which do not consider the actual condition of the infrastructure.

![Figure 10: Scheduled versa condition based maintenance](image)

6. CONCLUSIONS

Moving away from what seems to be a “proven solution since years” to new, innovative and cost effective solutions needs railways and decision makers who are ready to go for it. Clearly this is driven by costs and expected cost advantages which come to evidence at every application of these new solutions. It needs a innovative thinking and change of attitude of the single individual as well as the whole railway industry. Innovation and Australian tailor made solution are gaining popularity in past decade and will certainly promise a strong future for Australian railways.

6. REFERENCES

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