Modern technologies in design, construction and maintenance of railway turnouts –

Experiences with Turnout Refinements (ÖBB)

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Following the principles of an economic track, several track components in several basic and maintenance conditions and with different service lives need to be taken into account.

The cost driver on the Austrian track system is clearly identified. It is the yearly depreciation of the assets, followed by operational hindrances and maintenance costs.

Therefore 2 main strategies for an economic track are obvious:

- The initial quality must be the best possible and
- Doing proper maintenance to extend service life is the best you can do

By the way, ÖBB fully admit to an overall life-cycle-management for all kind of technical and maintenance strategies!

Depending on the parameters speed, tonnage and category of line, the following rail profiles are incorporated in turnouts together with wooden or concrete sleepers: 60 E1, 54 E2 or 49 E1 rail profile.
In Light loaded tracks, ÖBB tries to re-assemble rehabilitated turnouts in combination with new wooden bearers. This method helps us to reduce costs and do a proper recycling management.

For main lines in heavy loaded tracks with more than 30,000 Gross Tons/day or in tracks with a speed of more than 160 km/h, turnouts with 60 E1 rails and concrete bearers with under sleeper pads are standard in Austria.

In tracks between 10-30.000 GT/day, we prefer the 54 E2 rails with concrete or wooden bearers (depending on the material of the adjacent track sleepers).

Tracks with less than 10,000 GT/Tag are regularly installed with 49 E1 rail profiles and wooden bearers.

For the last 15 years, ÖBB introduced a lot of technical innovations in turnouts together with our contractor voestalpine to increase service live and to reduce maintenance cost for a better life-cycle-performance:

2000: New hydraulic force transmitting system “HYDROLINK®“ in the track center substituting the mechanical connection rods for a better track stability. New inductive obstacle detection of the switch – IS 2000 and the first prototype of the integrated switching system HYDROSTAR®

2002: 1st test trials for concrete bearers with under sleeper pads.

2005: Introduction of a hollow steel sleeper for better tamping and track geometry quality and a new, encapsulated locking device substituting the old clamp-lock, called „SPHEROLELOCK“.

2006: Hydrostar technology became standard for all high speed tracks with 200 km/h or above.

2007: all turnouts are equipped with a so called "Carrying capacity-optimized tongue geometry (TOZ)“ to improve service life span of a switch. The big ones (EW 1600/2600 and EW 10.000/4000) are carrying instead of TOZ a special kinematic gauge optimization (FAKOP) . The rail inclination was changed to 1:40 throughout the whole turnout, to fulfill TSI Infrastructure requirements.

To reduce costs, a direct fastening system from Vossloh was introduced in the closure and crossing panel together with integrated switch rollers on the bearers to increase availability. Additionally, the Steel grade R350 HT was applied in all 60 E1- and 54 E2-turnouts and under sleeper pads for all 60 E1-turnouts.
2011: the Carrying capacity-optimized tongue geometry was adopted also for 54 E2- und 49 E1-turnouts as well as the steel grade R350 HT.

Last but not least, a new electro-mechanical monitoring system for the switch position - IE 2010 - became standard.

The Austrian Federal Railways assemble turnouts for speeds of 200 km/h or above with a so called “common crossing with moveable point”. This technical solution ensures a continuous running of the wheel at the point, a dramatically reduced noise emission and ground born vibration and a much better track quality and durability throughout the entire service life.
ÖBB has solved the problem of the bending and inclining of the turnout from its beginning to the end with increasing exposure time. Since 2002, we successfully apply Under Sleeper Pads underneath the bearers for more than 800 turnouts. The reduction of the ballast bed stresses and the much better elasticity causes a better track geometry, reduced maintenance actions (particular tamping) and costs. Three different elasticity’s of the under sleeper pads within one turnout result in a constant settlement at different bedding conditions throughout the whole turnout.

The Under Sleeper Pads reduce settlements dramatically and gives a better track durability!

Today, modern turnouts are assembled with all combination of modules for setting, locking and position monitoring completely at the plant. This "plug and play turnout" can be delivered by special tilting wagons to the construction site just in time.

The in-placement with crane on a pre-compacted ballast bed shortens installation time and reduces track possession.

From the early beginning, the laying of turnouts (S&C) has been done manually at the construction site according the following process:

![Diagram of turnout laying process]

The rails, bearers, setting and monitoring system are delivered to the construction site, unloaded and assembled with a lot of manual employees directly at the construction site.

Today, modern turnouts are assembled with all combination of modules for setting, locking and position monitoring completely at the plant.

This "plug and play turnout“ will be delivered by special tilting wagons to the construction site just in time. The unloading and installation is done by big railway
cranes. After connecting to the interlocking and the welding of the rails, the turnout is ready to start operation.

S&C laying with tilting wagons and crane has only small economic advantages, but

- increases S&C quality (pre-assembly at the plant)
- increases quality for S&C laying
- reduces installation time
- shortens track possessions and gives a
- higher service life due to better initial quality

Last year ÖBB installed around 70% of all 49E1/54 E2 turnouts and 98% of all 60E1 turnouts with tilting wagons and cranes!

Especially HS tracks require a deliberate and optimized maintenance concept due to the high degree of mechanization – e.g. ETCS, GSM-R, fire doors, and so on.

Together with Robel Bahnbaumaschienen, ÖBB has developed a Mobile Maintenance Unit for inspection and minor maintenance works on the track like welding, screwing or changing isolated joints for example.
The advantages are of major importance:

- Due to all-round protection, the highest safety for maintenance workers are guaranteed
- A high working quality can be assured due to an optimally timed operation of machines and tools integrated in the unit
- The entire work area is illuminated
- The wind and weather protection enlarges working time and increases safety at work

One of the most interesting benefits is the protection of the workers from aerodynamic effects of passing trains. That’s why no speed restrictions occur on the nearby tracks in case of maintenance works.

*Let me finally summarize:*

There are 2 main strategies for an economic track:

- we insist on best initial quality for track components and track laying and
- extending service life by doing proper maintenance is required

The main refinements in turnouts are:

- 60 E1-rails with concrete sleepers and USP
- high quality driving, locking and detection system
- completely pre-assembled at the plant and a
- mechanized installation with cranes and tilting wagons