

**Modern technologies in design, construction and maintenance of railway turnouts -**

# **Experiences with Turnout Refinements**

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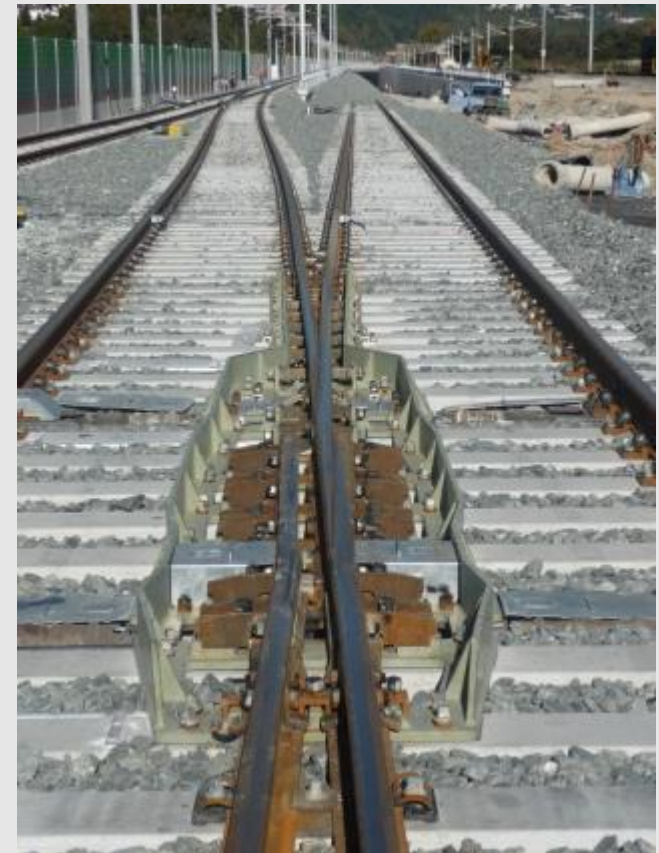
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# Austrian Federal Railways (ÖBB) - Factsheet

## Republic of Austria:

size: 83.871 km<sup>2</sup>

9 provinces

Inhabitants: 8,5 Mio.

Capital: Vienna (1,8 Mio.)

## ÖBB - Network:

4.846 km length

1.250 km HS – Lines (TEN)

9.646 km total track length,

13.760 turnouts

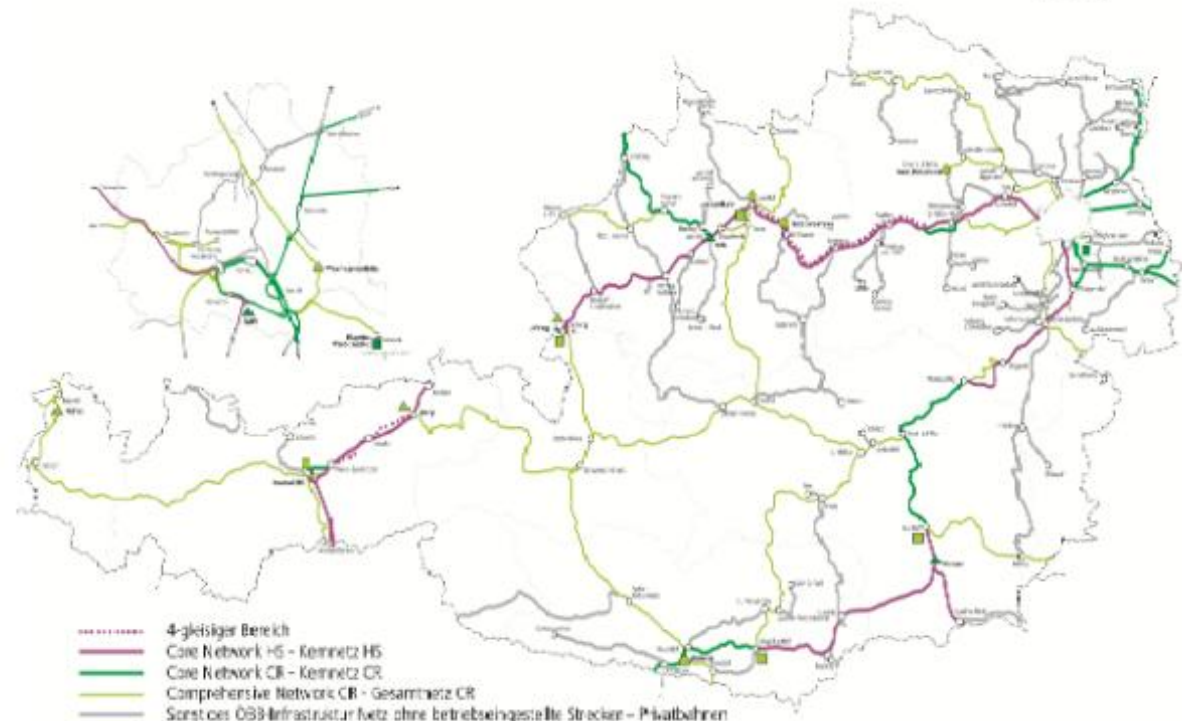
25.361 signals

6.327 bridges and viaducts

246 tunnels and galleries

3.398 railway crossings

1.095 stations



# Main strategies for ballasted tracks

The Track System consists of several components in several basic and maintenance conditions and with different service life's.

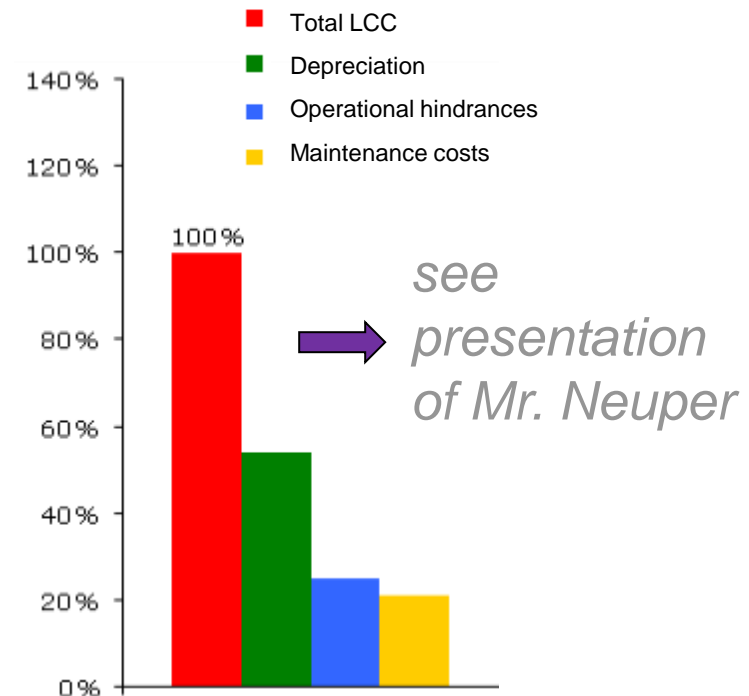
Since 1998 ÖBB has introduced a life-cycle-based maintenance and technology strategy, developed and pushed forward together with the TU Graz.

**Cost driver of the track system in Austria is the yearly depreciation of the assets**



## 2 main strategies for an economic track:

- best initial quality (track components and track laying)
- extending service life by doing proper maintenance

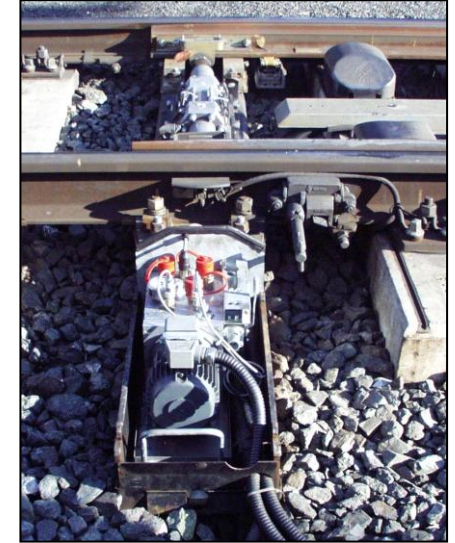
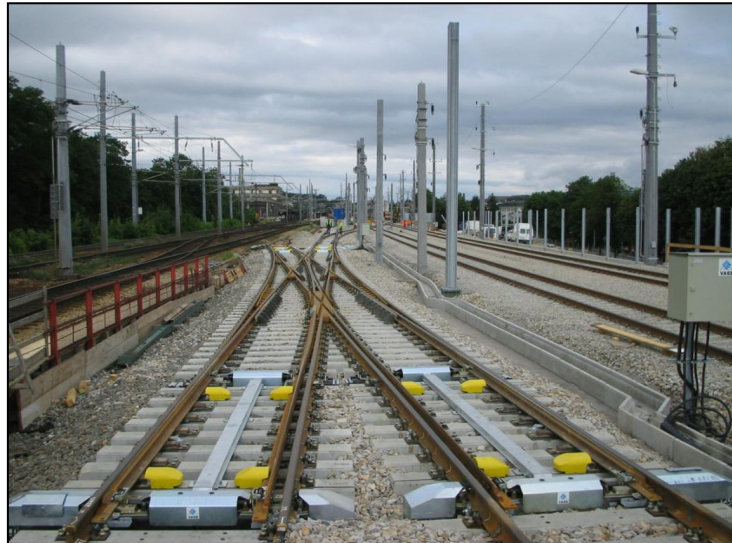




# Modern S&C - technology

## Requirements for ÖBB

- high quality materials (rails, bearers, locking) for long service-life and reduced maintenance
- completely pre-assembled at the plant
- mechanized installation (crane, tilting wagons)
- extended inspection intervals (6 month)



# Main strategies for turnouts

Depending on speed, tonnage and category of the line, the following **rail profiles** are incorporated in turnouts with **wooden** and **concrete** sleepers:

- 60 E1
- 54 E2 or
- 49 E1

Light loaded tracks: **rehabilitated turnouts** with new wooden bearers

- Turnout **component strategy**



*see presentation of  
Mr. Neuper*





# Historic development of modern turnouts

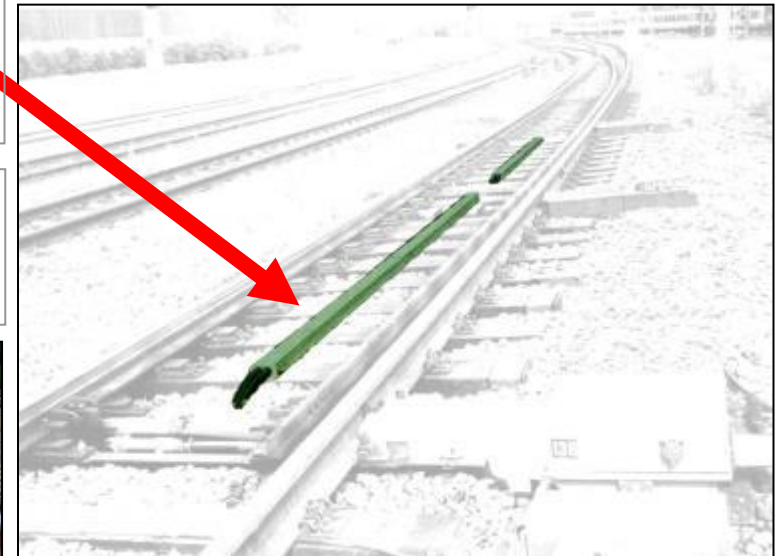
## Provisions to increase life span for turnouts in Austria

**2000:** New **hydraulic force transmitting system “HYDROLINK®”** in the track center substituting the mechanical connection rods for a better track stability.



hydraulic force transmitting system in the track center

Mechanical connection rods outside the track



# Historic development of modern turnouts

## Provisions to increase life span for turnouts in Austria

**2000:** New **inductive obstacle detection** of the switch – **IS 2000**

First prototype of the **integrated switching system** **HYDROSTAR®** for HSL



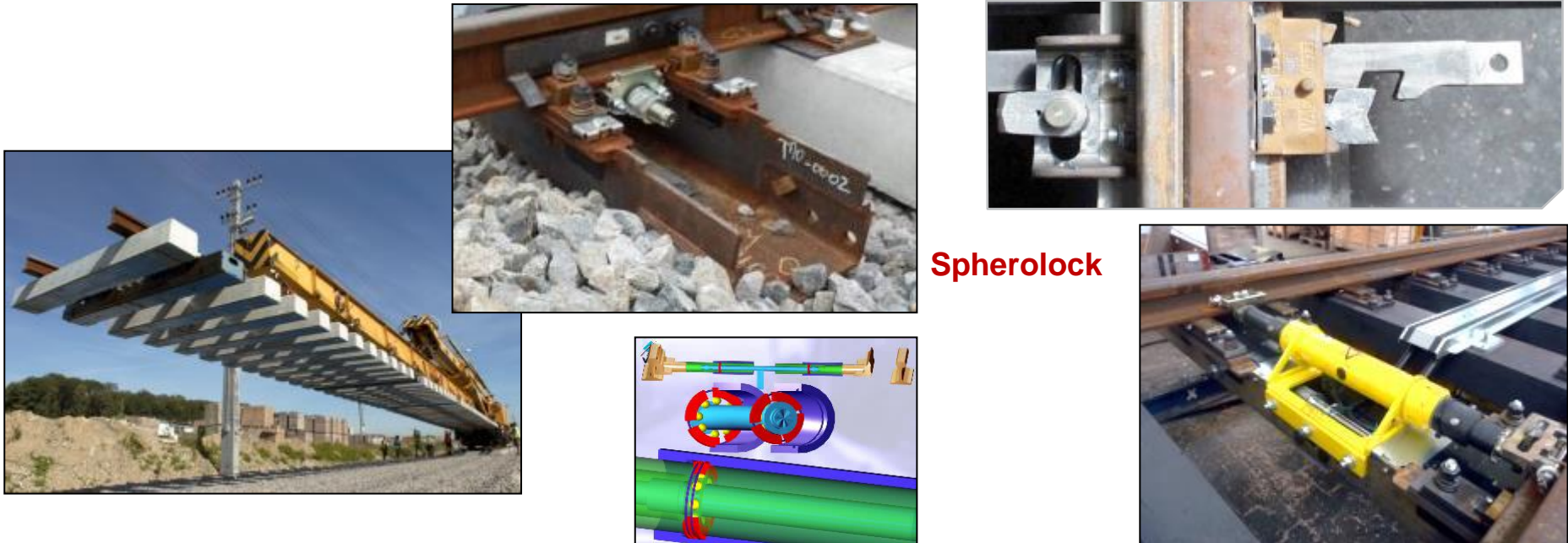
**IS 2000**



**Hydrostar®**

# Historic development of modern turnouts

## Provisions to increase life span for turnouts in Austria



**Spherolock**

- 2002:** 1<sup>st</sup> test trials with **concrete sleepers with USP** (under sleeper pads)
- 2005:** **Hollow steel sleeper** for better tamping and track geometry quality  
Introduction of a new, **encapsulated locking device** substituting the old clamp-lock → „**SPHEROLOCK**“



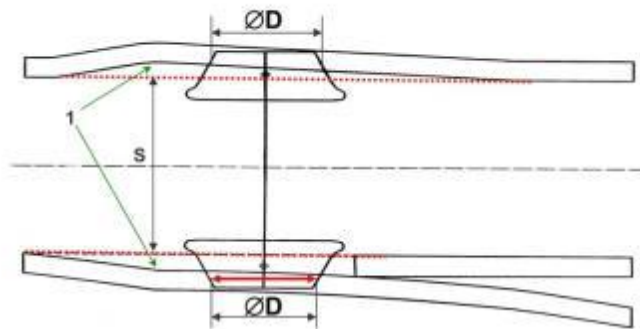
# Historic development of modern turnouts

## Provisions to increase life span for turnouts in Austria

**2006:** ***HYDROSTAR®** as standard for high speed turnouts (200 km/h)*

**2007:** Carrying capacity-optimized tongue geometry (**TOZ**) to improve service life span of a switch.

Kinematic gauge optimization (**FAKOP**) for EW 1600/2600 and EW 10000/4000



**Rail inclination of 1:40** throughout the whole turnout

Steel grade: **R350 HT** in **60 E1-** and **54 E2-**turnouts,

**Under sleeper pads** for all 60 E1-turnouts

# Historic development of modern turnouts

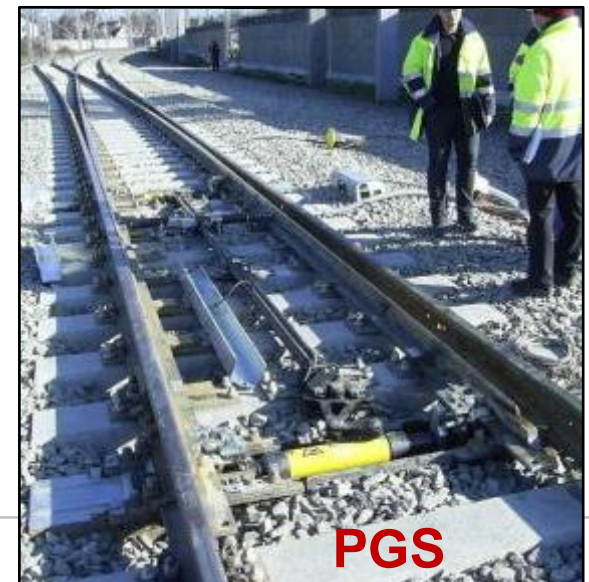
## Provisions to increase life span for turnouts in Austria

**2011:** New **electro-mechanical** obstacle-detecting system – **IE 2010**  
for conventional lines



**2015:** New mechanical connection rods in the track center – **Polygon setting device PGS** for conventional lines

**2016:** Test trials with steel grade: **R 400 HT**





# Actual turnout design at ÖBB

## Sherolock NG + polygon setting device (PGS)

**$v < 160$  km/h**



## *HYDROSTAR® for HSL*

**$v > 160$  km/h**





# Modern S&C technology

## Turnout geometry on HS-lines:

|                                |                |
|--------------------------------|----------------|
| EW 60 E1 - 500-1:12            | → v = 50 km/h  |
| EW 60 E1 - 1200-1:18,5         | → v = 100 km/h |
| EW 60 E1 - 2600/1600-1:24      | → v = 120 km/h |
| EW 60 E1 - 10.000/4000-1:32,05 | → v = 160 km/h |



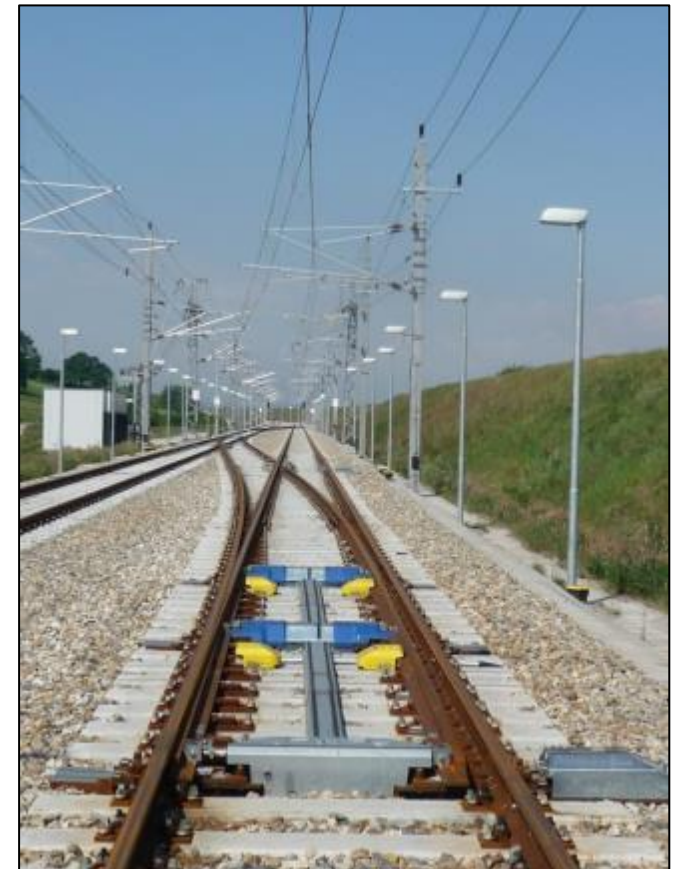
Steel grade: **R 350 HT**

**CENTRO Mn13** crossing,  
made from austenitic **high-manganese steel**, **explosive hardened**

Rail inclination = 1:40

Track gauge 1437 mm

Concrete sleepers with USP



# Modern S&C technology

## S&C with a common crossing and moveable point

Construction for tracks with  **$v > 160$  km/h**, **high tonnage** and **noise/ground born** sensible areas.

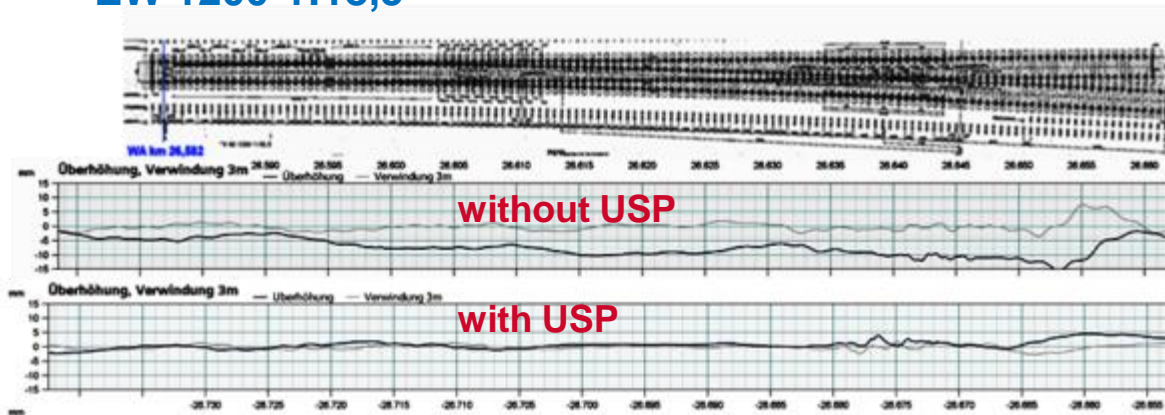
- continuous running of the wheel (no unguided length); no check rail
- no noise and ground born vibrations
- high service life
- no ballast destruction at the crossing



## Concrete bearers with under sleeper pads (USP)

Problem: bending and inclining of the turnout from its beginning to the end

EW 1200-1:18,5



- The reduction of the ballast bed stresses and better elasticity → **better track geometry, reduced maintenance actions and costs.**

USP: reduced settlements and better track durability !!





## Advantages of USP

- prevent from damage of the ballast bed
- better load distribution (8 % → 25 %) due to higher contact-areas between single stones
- better durability of track geometry
- extended tamping cycles (factor 1,5 – 3)
- reduction of corrugation in narrow curves
- reduction of ground borne vibrations (~30%)
- economic alternative to under ballast mats

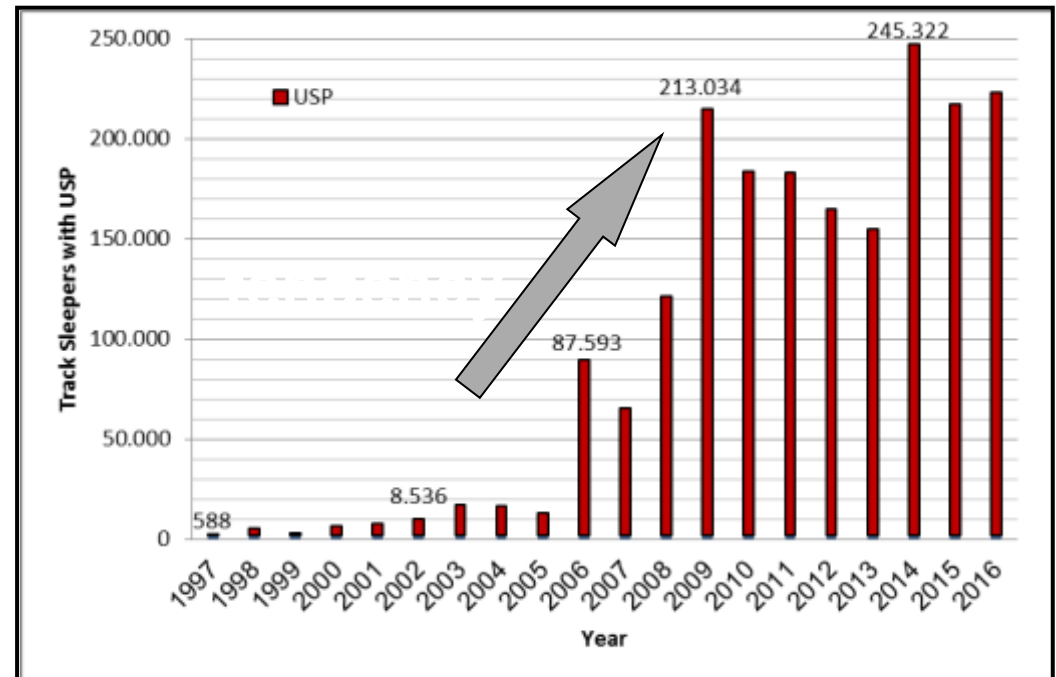


## Application of USP in turnouts at ÖBB

1<sup>st</sup> Application: 2002 crossover near Baden

*Amount of application at ÖBB:*

2002 – 2016: **> 1.200 turnouts**



# Modern S&C technology

## The “Plug and Play turnout”

- assembled with all combination of modules for setting, locking and position monitoring completely at the plant
- delivered by special tilting wagons to the construction site just in time.
- in-placement with crane on a pre-compacted ballast bed



Tilting wagons for turnouts



Assembly at the plant



In-placement with crane



# S&C laying – Pro`s and Con`s

## S&C laying with tilting wagons and crane:

Transport with tilting wagons and the in placement with crane on a pre-compacted ballast bed increased the overall performance of turnouts at ÖBB:

Only **small economic advantages**, but

- increased S&C quality (pre-assembly at the plant)
- increased quality for S&C laying
- reduced installation time
- shorter track possessions
- higher service life due to better initial quality



**ÖBB statistics (2016):** ~ **75%** of all 49E1/54 E2 turnouts  
 ~ **98%** of all 60E1 turnouts

## From strategy to modern turnout refinements

### Main strategies for an economic track:

- **best initial quality (track components and track laying)**
- **extending service life by doing proper maintenance**

### Main turnout refinements:

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



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