

# Ballasted track or slab track? What would be the best choice for the new high-speed lines in Sweden?

Stefan Marschnig Ass.Prof. Dipl.-Ing. Dr. techn.

Seminar Järnvägsgrupp, Stockholm 25<sup>th</sup> May 2016

# What is a modern high-speed railway track?

Life Cycle Cost approach:

Composition of normalised annual Costs  
Influence of Superstructure  
High-loaded, straight Track with good subsoil



↓  
Ballasted USP  
Track



↓  
Slab Track

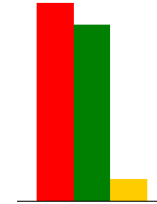
# Ballasted track or slab track?

## Ballasted track



- I Service life up to 40 years
- I Main maintenance job: tamping

## Slab track

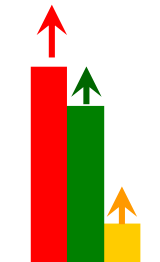


- I High investment (plus 20%)
- I Longer service life (60 years)
- I Almost "maintenance-free"

This is experience for mixed traffic and speeds up to 200 km/h...  
High-speed?

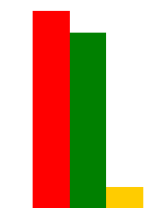
# Ballasted track or slab track?

## Ballasted track



- I Service life (ballast) decreases
- I Tamping demand increases

## Slab track

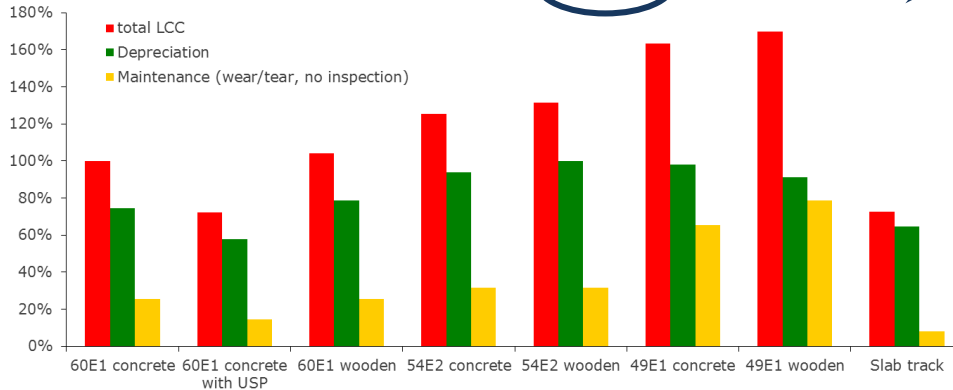


- I High investment (plus 20%)
- I Longer service life (60 years)
- I Almost "maintenance-free" ?

This is experience for mixed traffic and speeds up to 200 km/h...  
High-speed?

# Slab track – “maintenance-free”?

Composition of normalised annual Costs  
Influence of Superstructure  
High-loaded, straight Track with good subsoil



Good subsoil!

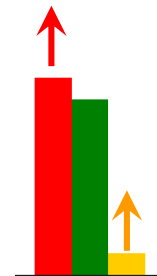
And for weak subsoil?

## Ballasted track



- ⓘ Service life (ballast) decreases
- ⓘ Tamping demand increases

## Slab track



- ⓘ High investment
- ⓘ Longer service life (60 years)
- ⓘ Maintenance on cracked concrete structure (>100€/m)

Once in service life? Twice...?

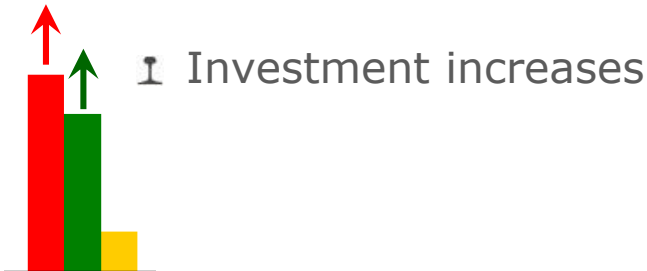


# Weak subsoil – alternative options?

## Investment in substructure

### Ballasted track

Load-distribution layer, asphalt layer



### Slab track

Pre-loading, soil improvement, soil replacement



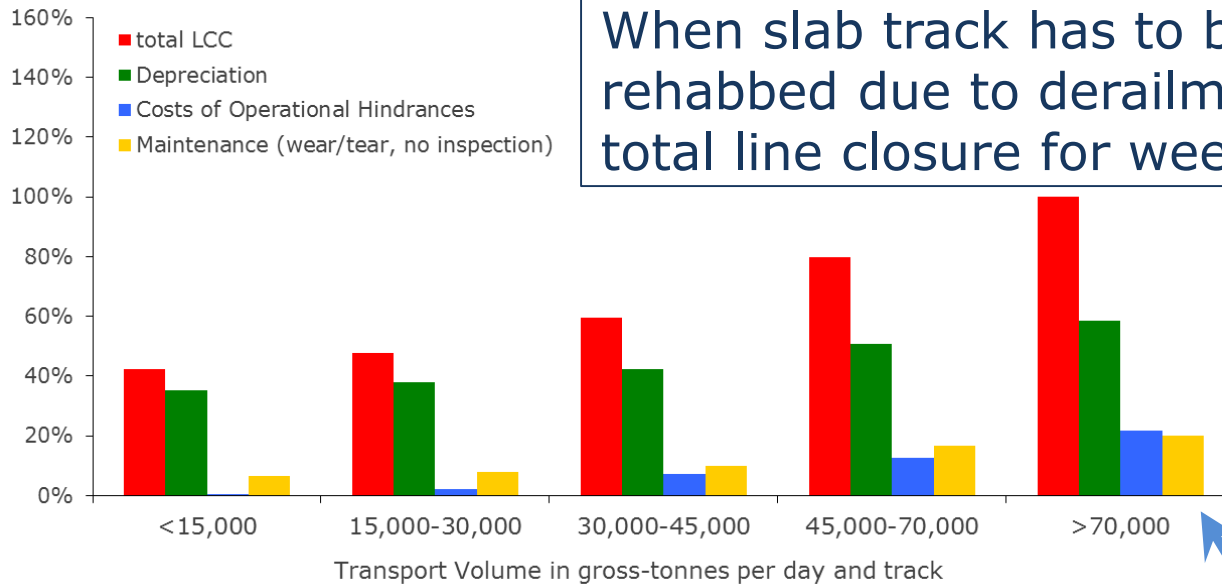
Alternative: concrete sub-structure (through-going bridge)



Investment explodes... (min. factor 3)

# Costs of Operational Hindrances

Composition of normalised annual Costs  
Influence of Transport Volume  
Straight Track with good subsoil and heavy superstructure



On very high loaded tracks, COH can double maintenance cost.

That counts again for slab track!

As long as there is no maintenance needed for it...

# Ballasted track or slab track?

## Both!

### Slab track

If boundary conditions are investigated in detail and found to be adequate for a slab track:

- ⌚ Different settlements? → on solid rock, in tunnels, and bridges
- ⌚ Climate (temperature, humidity,...)? → Concrete technology

### Ballasted track

In case of any doubt concerning the subsoil condition.

**A modern ballasted track (USP, high ballast quality, asphalt layer) is ready for speeds up to 350 km/h!**



# Ballasted track and slab track

Decision making section per section.

But:

Avoidance of too short sections.

Every change of superstructure/substructure (or generally: track stiffness) leads to a single failure being cause for problems on the subsequent sections.

In case of doubts → ballasted track can handle both, good and weak subsoil, slab track cannot.

# Summary

- i Slab track, wherever possible. It is an investment-intensive, but low-maintenance solution.
- i Detailed investigations – in case of doubts → ballasted track  
A modern ballasted track (USP, high ballast quality, asphalt layer) is ready for speeds up to 350 km/h!
- i Line design: Ballasted track and slab track!
- i **Don't forget the vehicle design!**  
Especially for the ballasted track, track-friendly technology (axle loads, axle distance, unsprung mass, radial steering) is mandatory to achieve a sustainable, economic track.

# Tack!

[stefan.marschnig@tugraz.at](mailto:stefan.marschnig@tugraz.at)

▶ [www.ebw.tugraz.at](http://www.ebw.tugraz.at)