Transition Design Developments

Barnaby Temple

Brian Whitney

Why Do We Require Transitions?

Problems

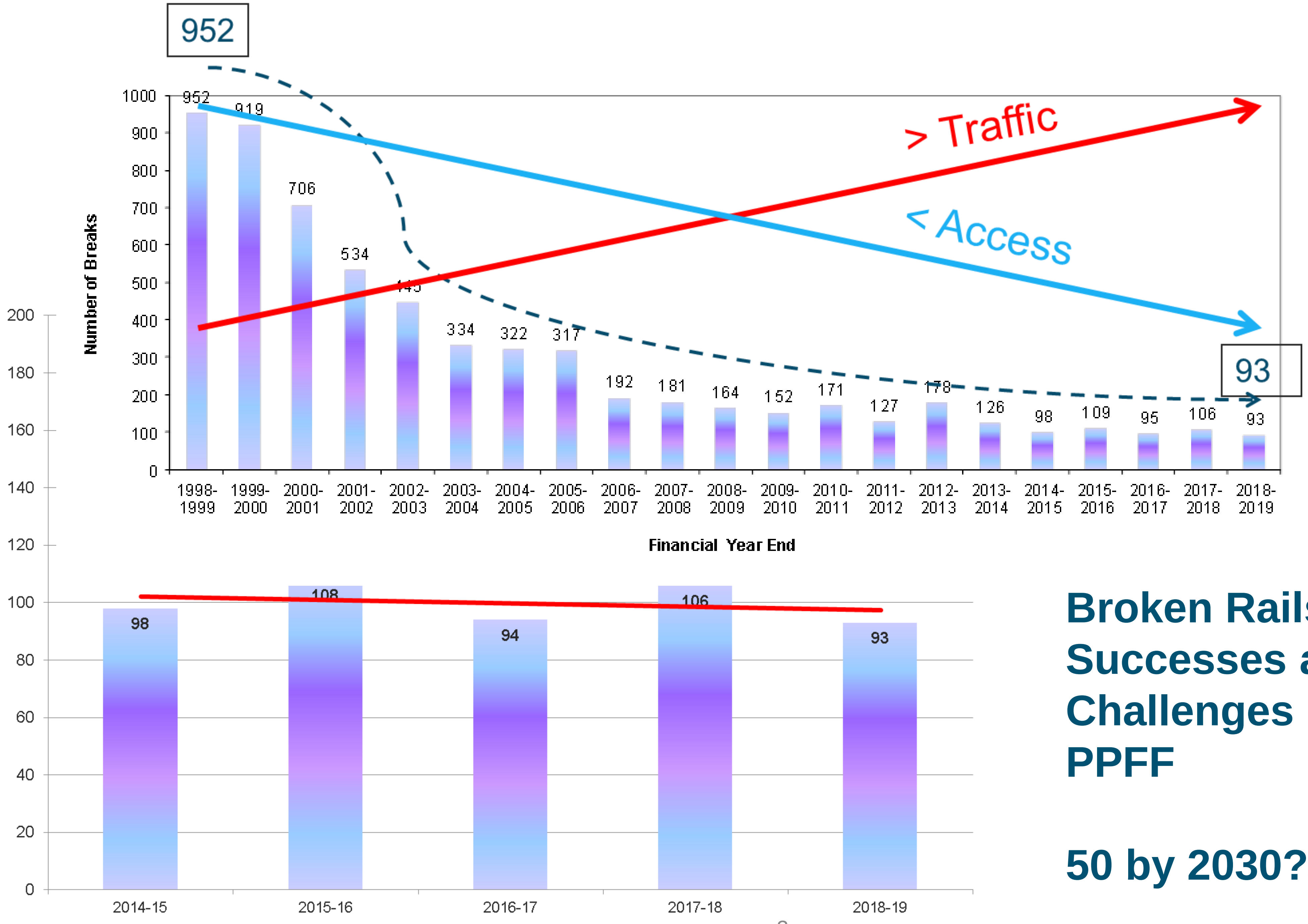
The Importance of Settlement and Stiffness

Loaded Deflection

Engineered Transition Designs

Practical Applications

Examples



Broken Rails Successes and Future Challenges PPFF

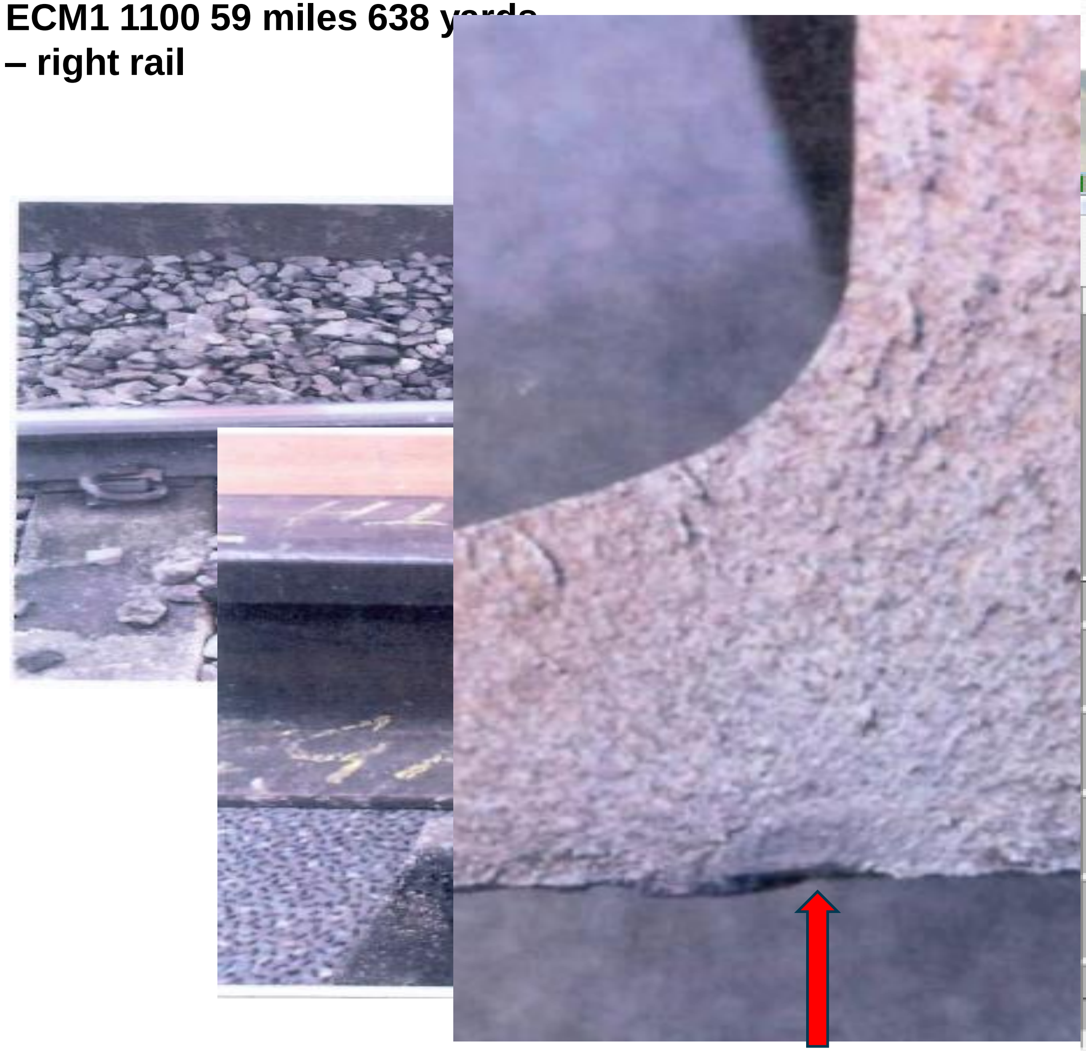
50 by 2030?

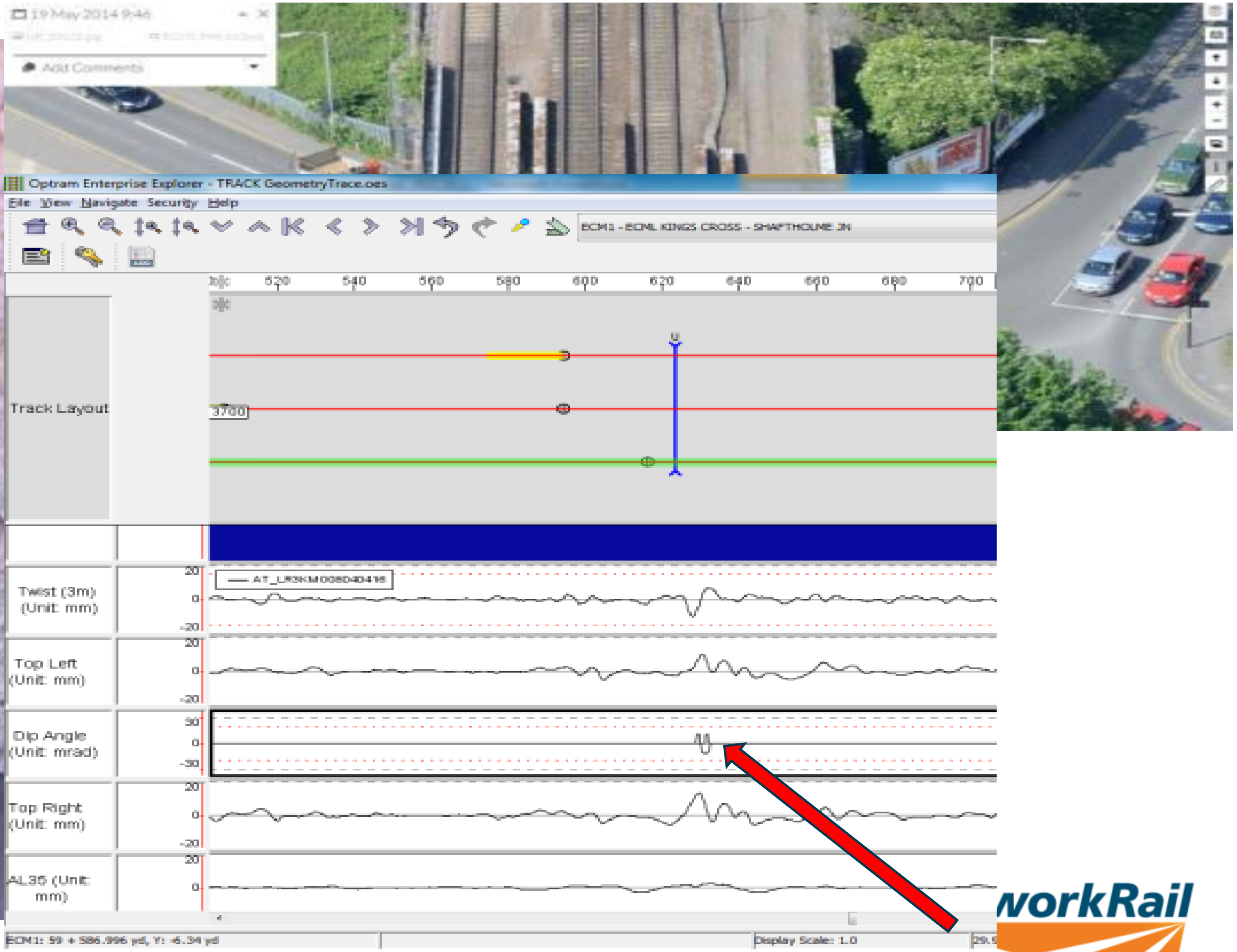
Poor or No Transition - Consequences

- Manual packing required - Sometimes very frequently (monthly)
- Broken rails (typically 20 to 30 per year), Foot Failures typically 50 per year, Reduced component life, Increased whole life cost
- Safety, Delays
- Not just stiffness changes – Need to consider ballast settlement, loaded deflection and development of voiding

Broken Rail (LNE)

Hazard Score: 51
Failure type: Broken Rail - gap in running table 75mm or less
ECM1 1100 59 miles 638 yards – right rail





Source: Hazard log

There has been a previous rail break at this location and the majority of rail breaks in the rail foot are caused by poor support conditions

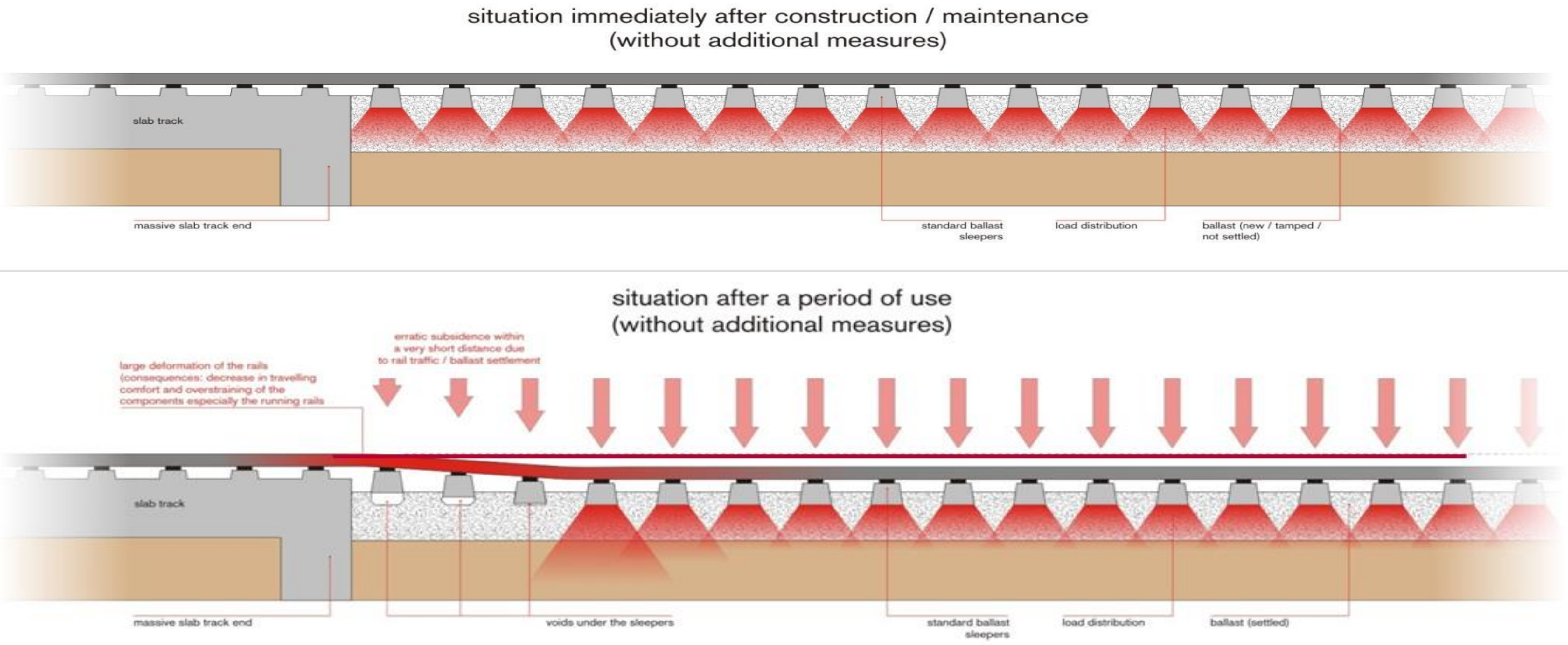
Not Just Traditional Transitions

RHOMBERG SERSA RAIL GROUP

Excessive deflection and poor / variable support conditions
Increased Settlement, Voiding, Increased Dynamic Loading, Increased Settlement, High Bending Stresses, Reduced Life, Failures, Delays

NetworkRail

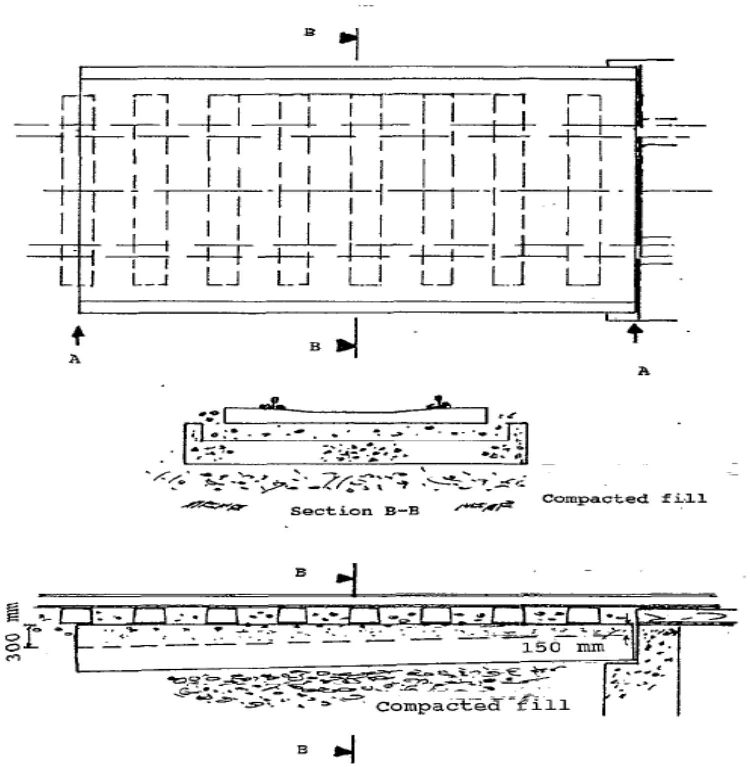
Bridge / Slab TransitionDiagrammatic Explanation

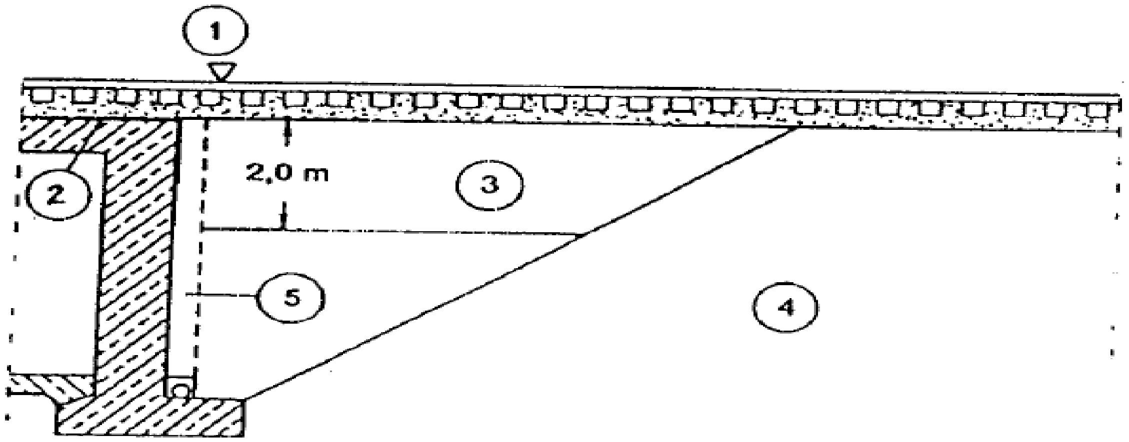


Barnaby

Traditional solutions

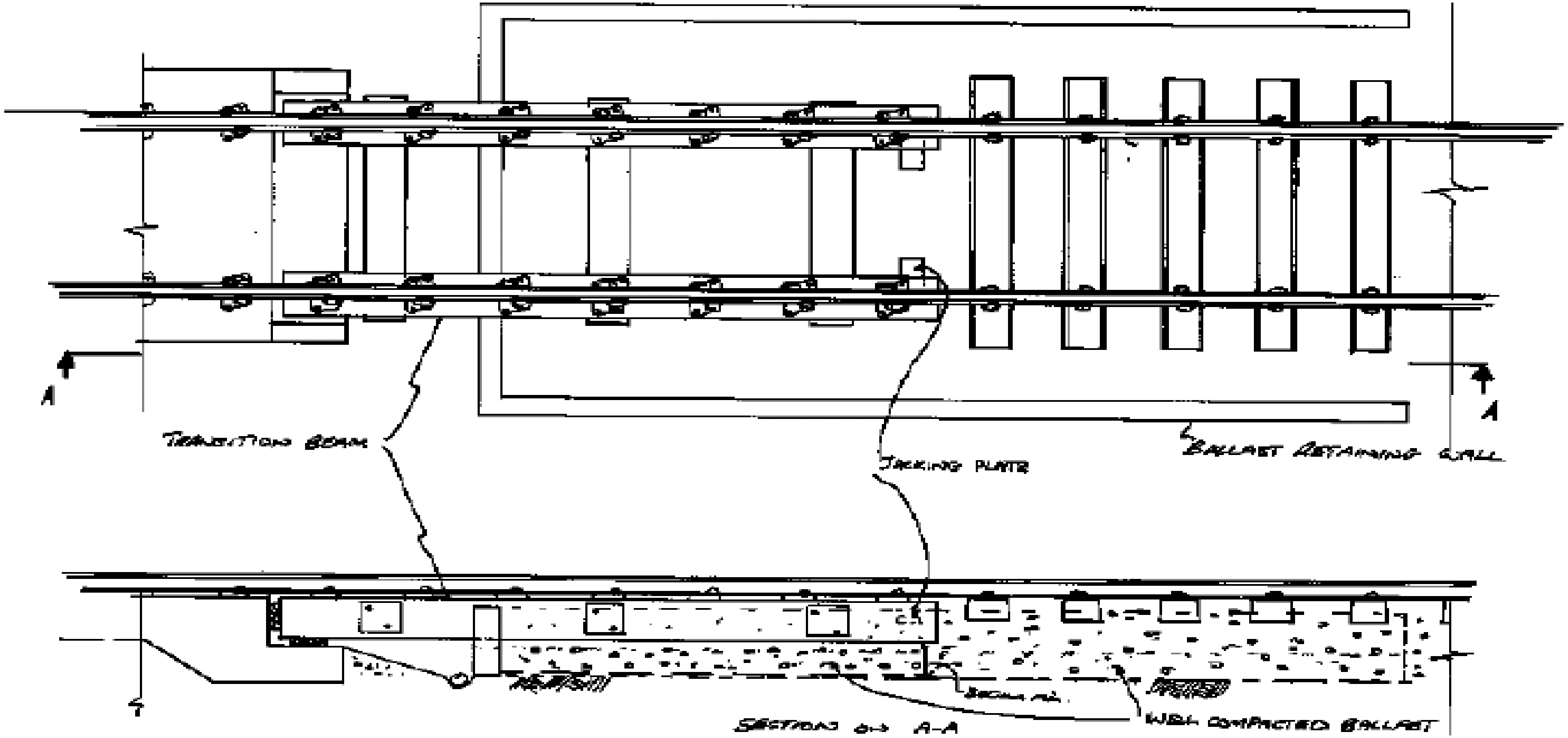
- **A buried/under-ballast slab**
  - Intended to avoid soft fill effects
  - Results in ballast attrition and voids
  - Sometimes a ballast mat specified
  - Trough helps confine ballast
  - End is another transition
  - Differential settlement still prevalent
- **Wedge form embankment stiffening**
  - Aims to minimise settlement
  - New-build solution
  - Not so easy for an existing structure





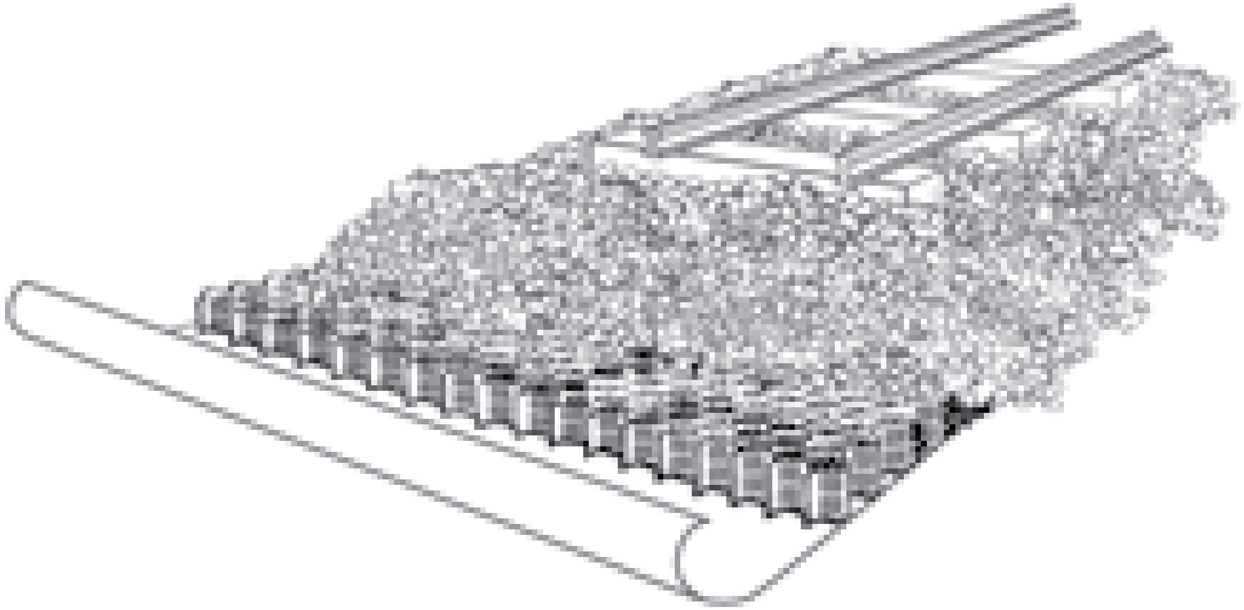
BR Solution – 1980's

- Developed for slab track
- Pre-cast concrete beam ~4.5m long, bearing on the slab end
- Features a ballast retaining wall, packing plates
- Not much resilience, but adjustable and spans void risk area



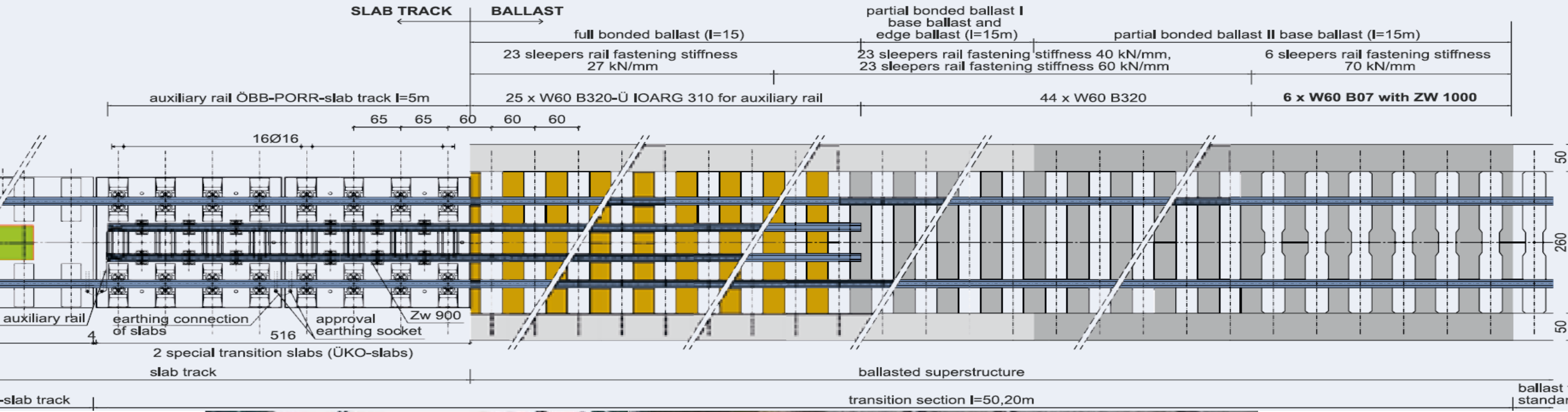
Modern Alternatives

- **Sleeper Soffit Pads**
  - Shown to reduce ballast settlement
  - Can help design a smoother stiffness change
- **Geoweb/geogrids**
- **Piling**
- **XiTrack**
- **DB high speed**
  - Lots of gluing (they use epoxy)
  - Strap rails on special/bridge sleepers
  - Formation stiffening measures
- **Steel transition module (V-TRAS)**
  - As part of a system



Slab track systems

Transition between slab track and ballasted track (glue and rails)



East London Line

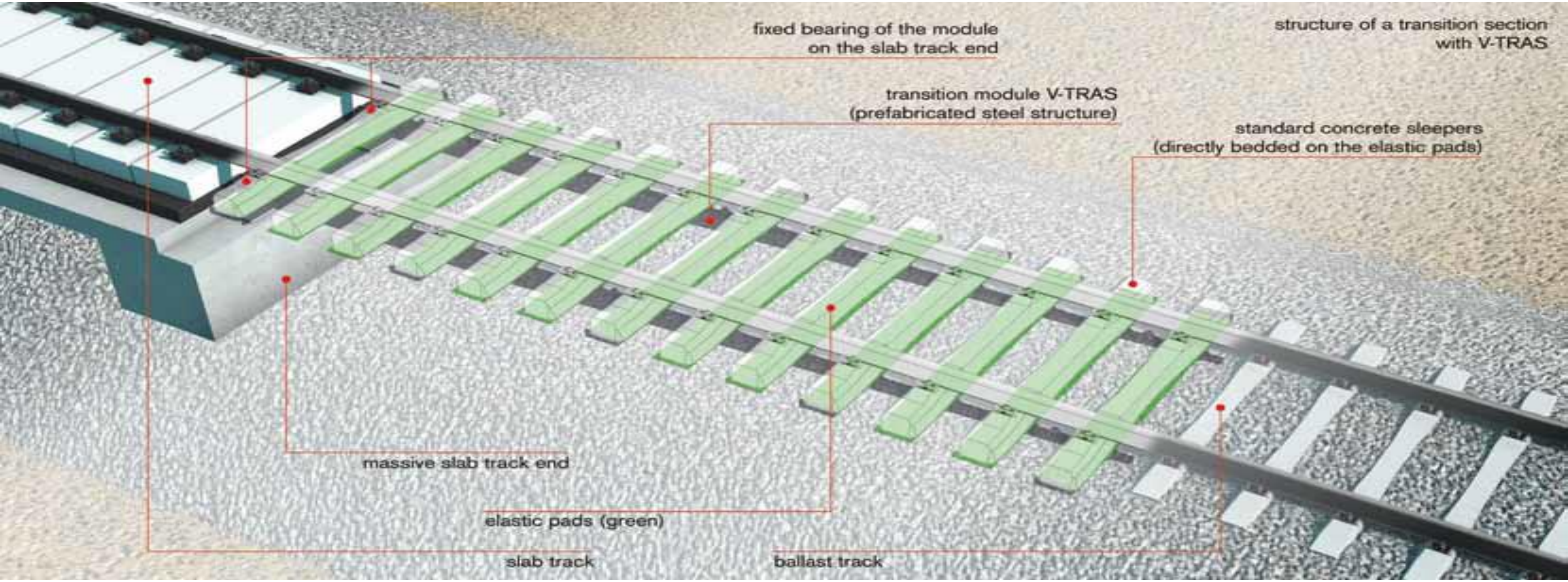
XiTrack used in shoulders

& in bottom ballast

NetworkRail

Rhomberg Sersa – V-TRAS

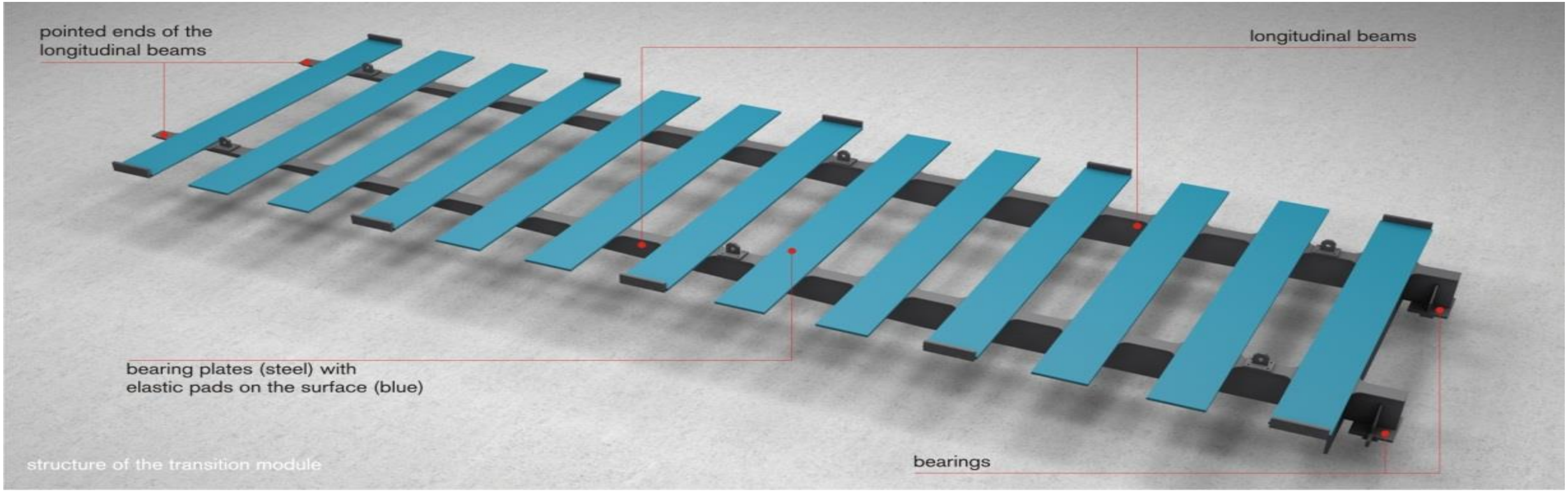
Modular Ballast to Slab Transition



Rhomberg Sersa – V-TRAS

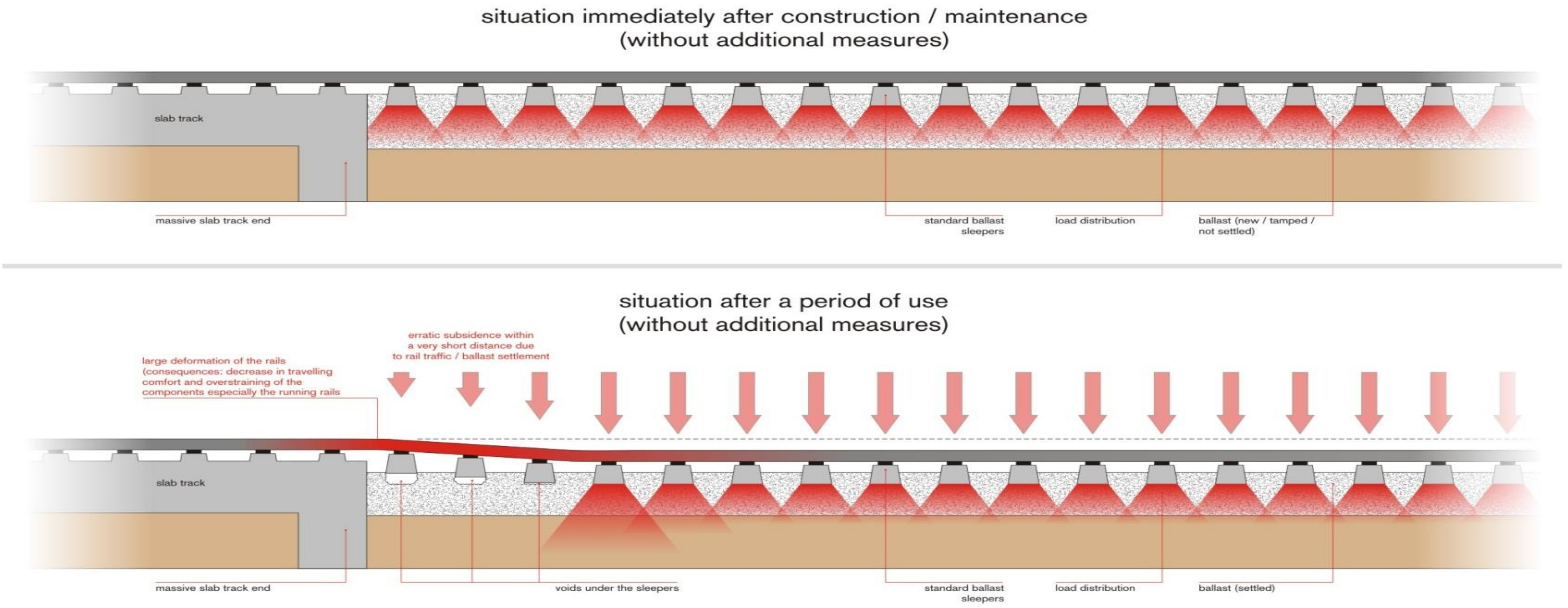
Modular Ballast to Slab Transition

- Pre-fabricated steel structure



Rhomberg Sersa – V-TRAS

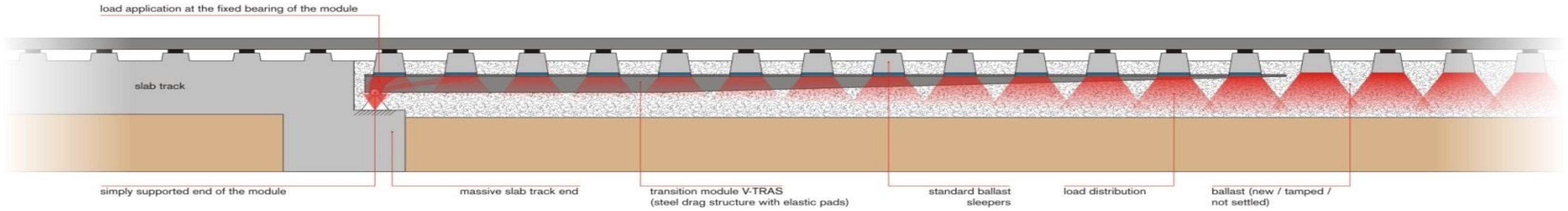
Modular Ballast to Slab Transition



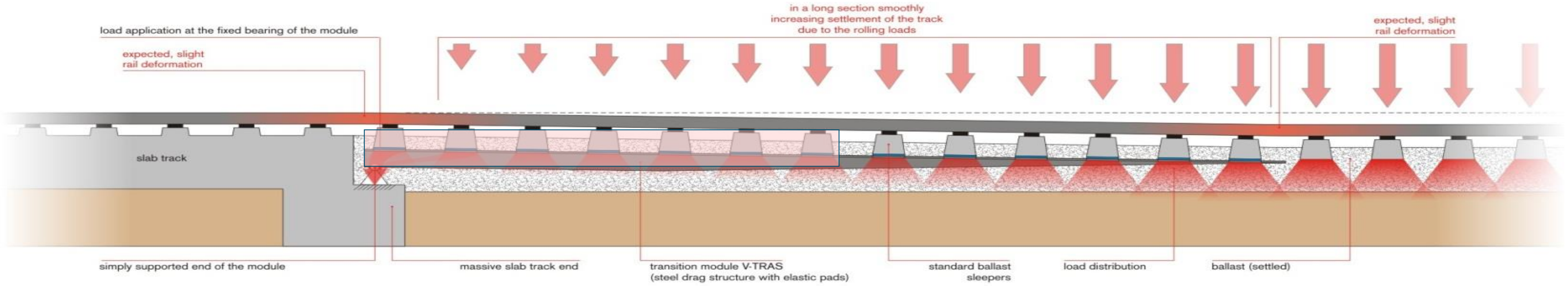
Rhomberg Sersa – V-TRAS

Modular Ballast to Slab Transition

situation immediately after construction / maintenance



situation after a period of use



Universal Transition Module V-TRAS
Main Benefits

- Reduced rate of differential settlement
- Reduced consequence of differential settlement
- Reduced frequency of intervention to correct level defects
- Reduced dynamic impact due to void formation
- Reduced risk of rail and component failures
- Easy correction of construction failures and operation defects
- Unrestricted involvement in additional track equipment (e.g. derailment provisions)
- Usable on any kind of slab track type and bridges
- Elasticity can be adjusted to suit application if required

Queen Street installation in cutting

Ballast compacted under V-TRAS adjacent gabion wall

A System Solution for a Transition Zone
What this means and how to get there

Key requirements:

- **Deal with settlement risk**
  - Bridge it
  - Confine it
  - Support it
- **Manage the ballast**
  - Confine it
  - Support it
  - Ensure buckle and twist risks are minimised
- **Manage the Formation and Drainage**
  - Adequate stiffness and compaction
  - Longitudinal and transverse falls
  - Capacity
- **Corrosion**
  - Ground water
  - Protective coatings

A System Solution for a Transition Zone
Practical actions

Design stage:

Site Investigation

- Soils/Formation/track bed
- Drainage & ground water
- Survey

Risk assessment

- Identify particular considerations
- Bridge articulation/movement
- Curves and rail stressing

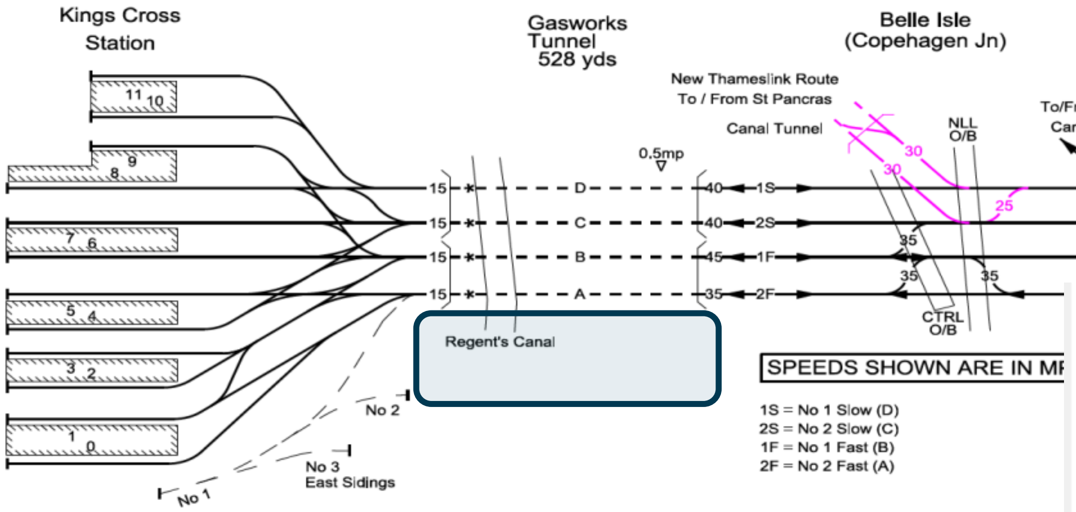
Detailed design

- Settlement control
- Stiffness change through transition zones

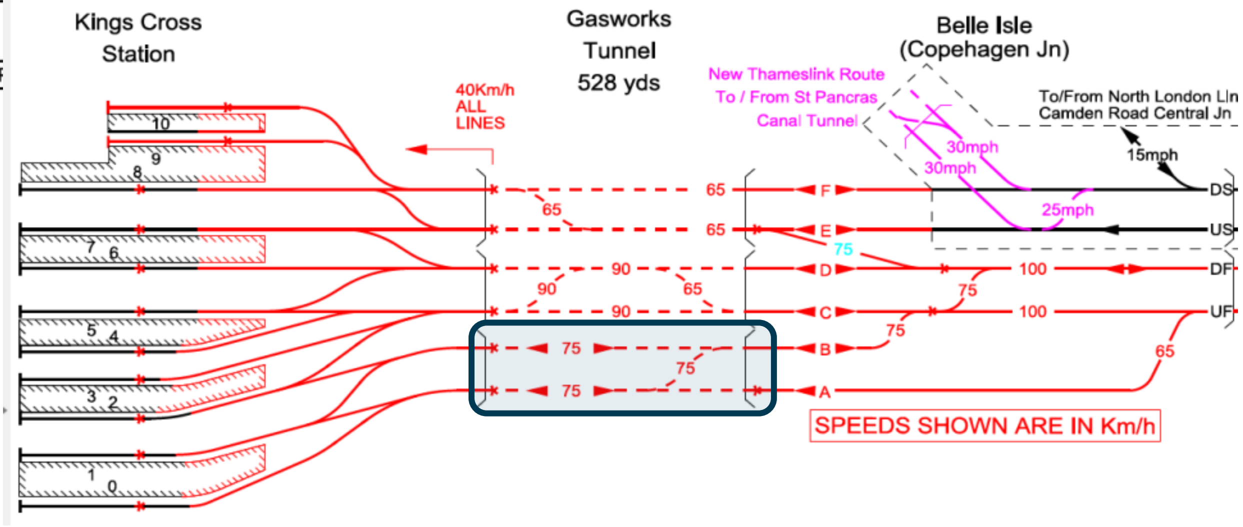
Installation stage

- Suitable work window and schedule/order of actions
- Testing of formation compaction
- Care on levelling and packing to achieve designed solution

Remodelling of the Junctions in Station Throat & Through Tunnel



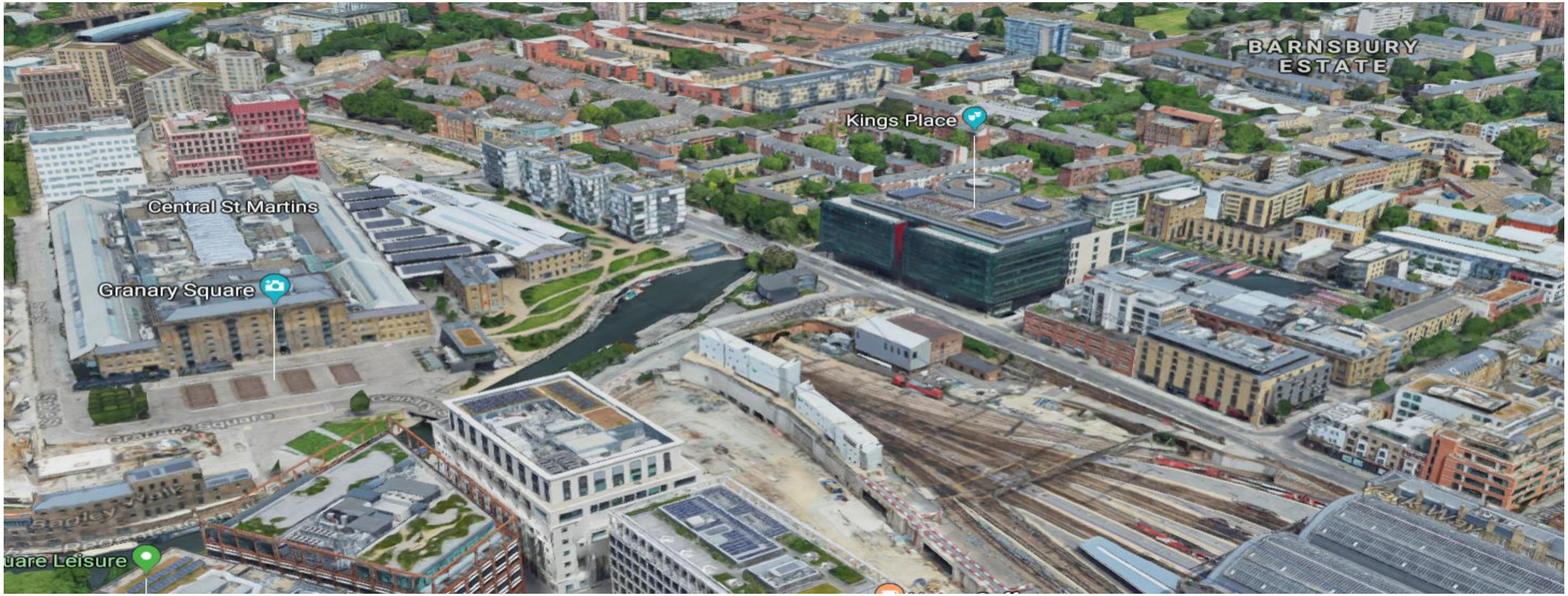
» Rhomberg Sersa UK (RSUK) was awarded a design subcontract in 2018 for Preliminary Design and subsequent Detailed Design, with FCP.VCE as specialist designer
» End Client is Network Rail
» Principal Designer is Amey Consulting
» Principal Contractor is Network Rail in Alliance with various construction companies according to discipline



» RSUK are also contracted to build the slab track through the East Bore of Gasworks Tunnel

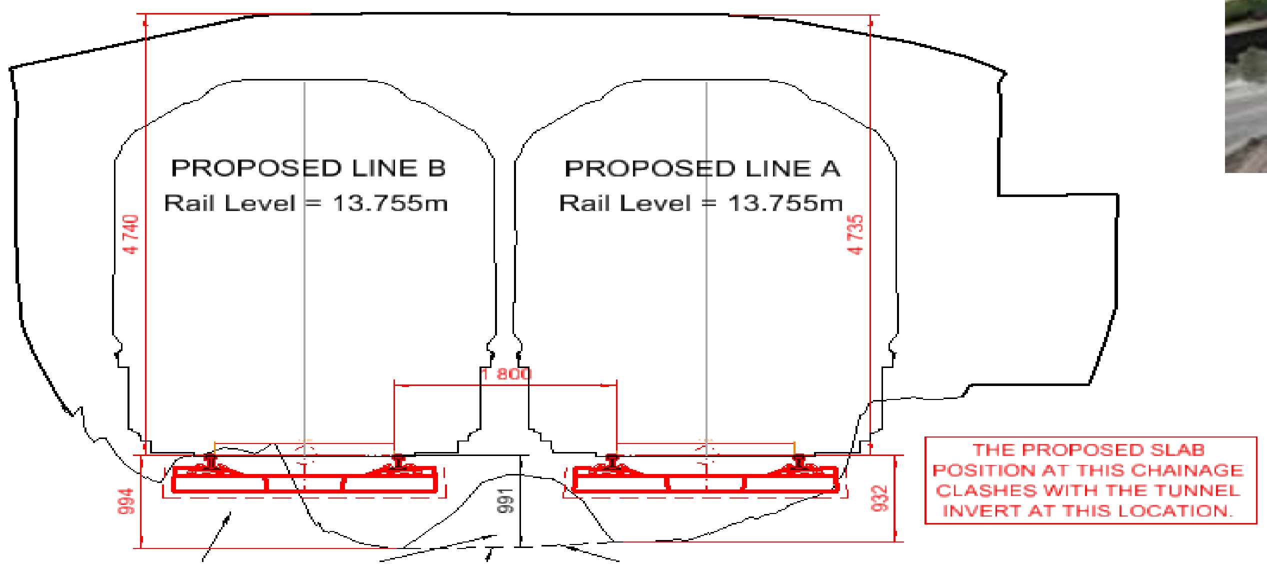
» Construction planned for Q4 2019

View from South (West), Station side

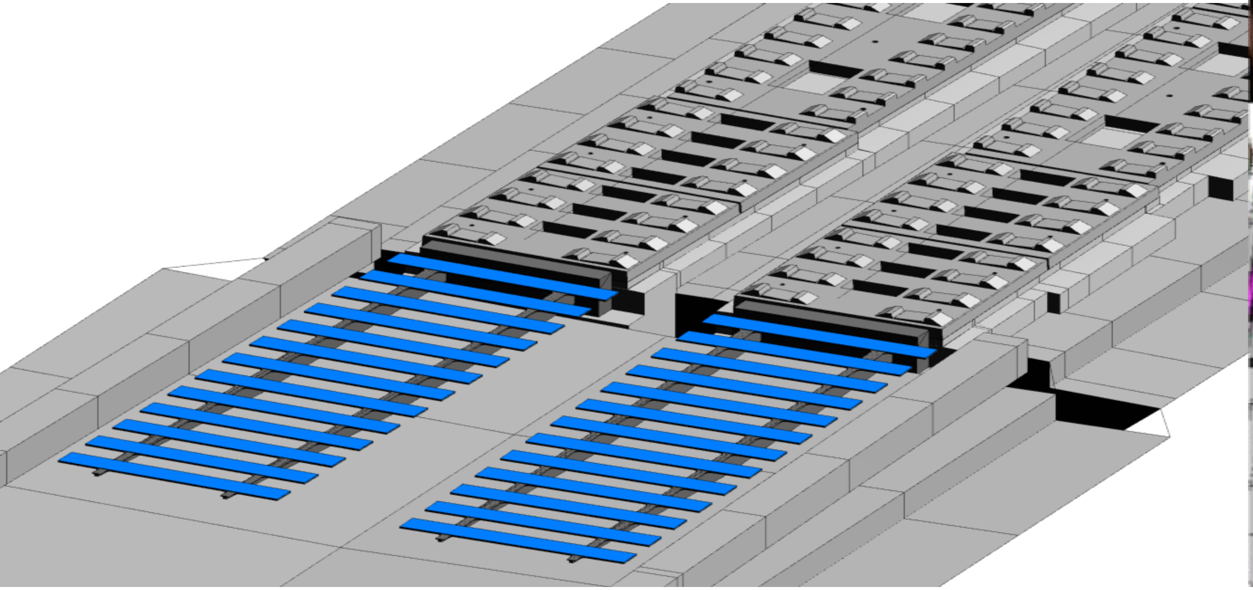


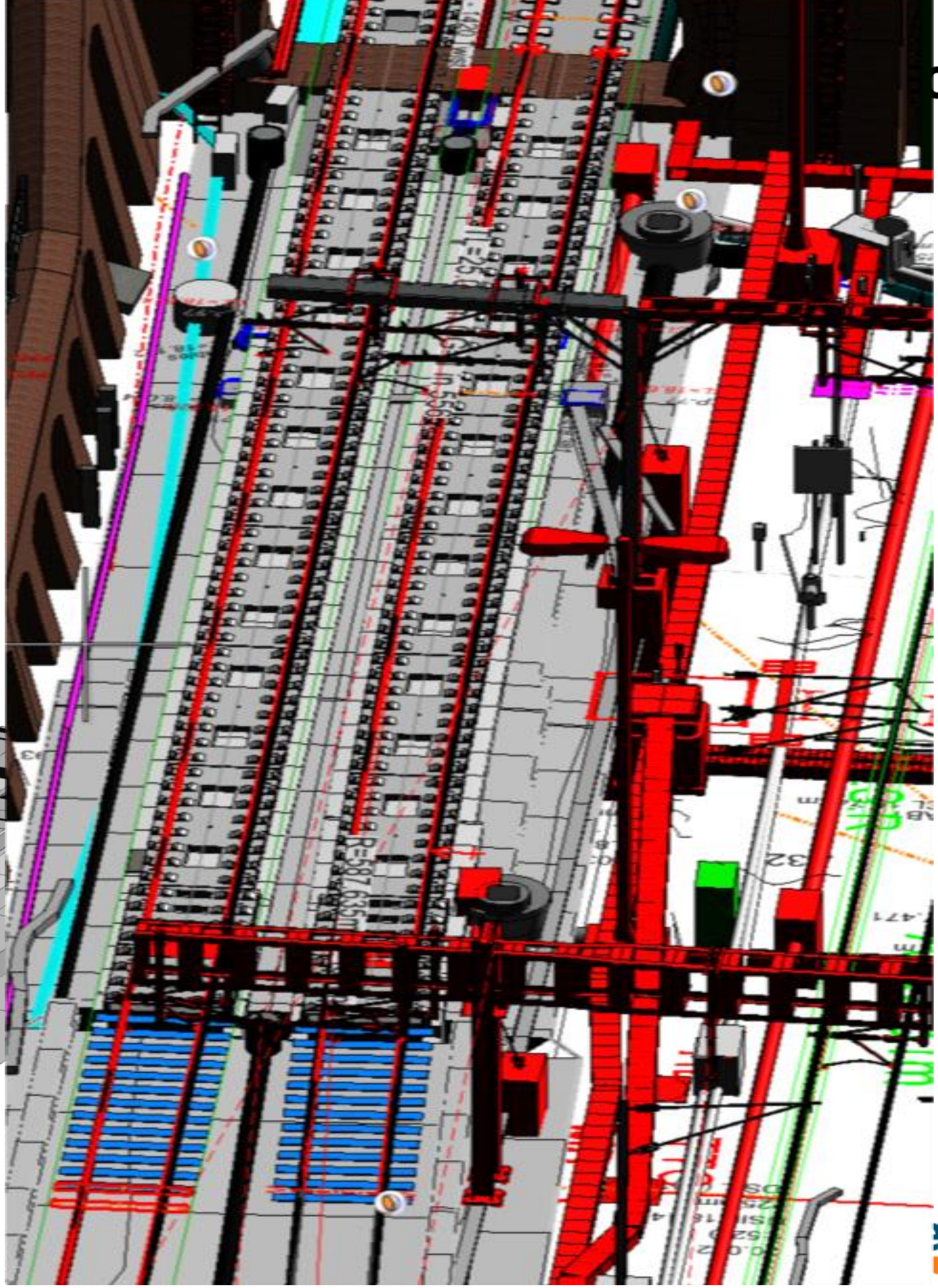
Why Slab Track?

- Fitting track and electrification was the challenge at feasibility
- Even discrete rail seats were a challenge to fit in an in-situ concept
- Ballast – sleepers could not fit!
- 2.1m wide variant of Porr STA was proposed
- Consequently a team of RSUK with key suppliers Porr and designer VCE.FCP were engaged
- Under the canal was the tightest point



Kings Cross Remodelling
Transition zone north





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Thank You

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