INNOVATIVE SLAB TRACK CONCEPTS
(generation, selection & design)
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Track engineer
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1.- WHAT DO WE MEAN BY HIGH CAPACITY?
(with regard to the superstructure system)

- Co-existence of freight and passenger traffic (structural resistance)
- Possibility for (fast) correction of levelling problems
- Fast correction of defects (cracks, breakages, fissures, etc.)
- RAMS:
  - R (Reliability): high MTBF (good design and components)
  - A (Availability): low MTTR \[ \text{Intrinsic availability} = \frac{MTBF}{MTBF+MTTR} \]
2.- OVERVIEW OF EXISTING SLAB TRACK SYSTEMS

- Analysis of performance and maintenance issues in terms of high capacity.

<table>
<thead>
<tr>
<th>TRACK TYPE</th>
<th>PREVENTIVE REPARATION</th>
<th>CORRECTIVE REPARATION</th>
<th>GEOMETRIC CORRECTION</th>
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<tbody>
<tr>
<td>Embedded rail</td>
<td>Low frequency</td>
<td>Low frequency</td>
<td>Complicated</td>
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<tr>
<td>Direct support</td>
<td>Frequent</td>
<td>High frequency</td>
<td>Need for reconstruction</td>
</tr>
<tr>
<td>Indirect support</td>
<td>Frequent</td>
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<tr>
<td>Elastomeric coated blocks</td>
<td>Periodic, especially in fastening systems</td>
<td>Problems with water filtrations</td>
<td>Possible replacement of elements</td>
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<tr>
<td>Monolithic with sleeper</td>
<td>Periodic, especially in Fastening systems</td>
<td>Possible replacement of elements</td>
<td>Possible replacement of elements</td>
</tr>
<tr>
<td>Elastomer coated sleepers</td>
<td>Periodic, especially in Fastening systems</td>
<td>Problems with water filtrations</td>
<td>Possible replacement of elements</td>
</tr>
<tr>
<td>Sleepers on slab</td>
<td>Periodic, especially in Fastening systems</td>
<td>Possible replacement of elements</td>
<td>Possible replacement of elements</td>
</tr>
<tr>
<td>Floating slab with Sleepers</td>
<td>Periodic, especially in Fastening systems</td>
<td>Possible replacement of Elements</td>
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</tr>
<tr>
<td>Slabs on non-elastic mortar</td>
<td>Periodic, especially in Fastening systems</td>
<td>Possible replacement of elements</td>
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3.- NEW DESIGN REQUIREMENTS AND METHODOLOGY

- Geometrical requirements:
  - Cost-effective track and layout parameters
  - Reduced height and weight
  - Integration of signaling systems
  - Effective drainage

- Mechanical requirements:
  - Non-settling subsoil
  - High quality of supporting structure
  - High quality of earthworks
  - Adequate track stiffness
  - Compatibility with structures (bridges...)

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3.- NEW DESIGN REQUIREMENTS AND METHODOLOGY

- **Environmental requirements:**
  - Including noise and vibrations absorbers
  - Use of 2\textsuperscript{nd} life materials (recycled or waste)

- **Construction requirements:**
  - Few construction stages
  - Fast construction and assembly
  - Modularity
  - Easy transport of prefabricated elements
  - Easy fitting to alignment
3.- NEW DESIGN REQUIREMENTS AND METHODOLOGY

- **Maintenance requirements:**
  - Low maintenance
  - Easy replacement of components
  - Well-defined procedures for repairing unforeseeable events

- **Cost requirements:**
  - Low construction cost
  - Low maintenance cost (less than ½ of ballast systems)
  - Long life cycles (60 yrs)

Weighing up the pros and cons of all requirements

Modular slab track is an optimal solution
4.- TRACK CONCEPTS: SELECTION AND DESIGN

- How do we face this challenge?

**SP1 → WP1.1. → Multi-skilled team**

- Concept design of 2 alternatives
- Collaborative workshops

**RAMS-oriented concept**

**LCC-oriented concept**
4.- TRACK CONCEPTS: SELECTION AND DESIGN

- Methodology for the design

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<th>Business model</th>
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<td>Stiffness levels calculation</td>
<td>Subgrade calculation</td>
<td>Earthing, Stray currents</td>
<td>Construction process and costs</td>
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<td>Dynamic calculation</td>
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<td>Signalling equipment</td>
<td>LCC model</td>
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4.- TRACK CONCEPTS: SELECTION AND DESIGN

- **1st design: 3MB modular slab track system**
  Multi-Moulded Modular Blocks

**INNOVATIVE FEATURES:**
- Module & independent blocks allow faster replacement
- No rail lifting for block replacement.
- System of pins for stopper and adaptation in curves.
- 3MB can be laid on asphalt or bituminous bed.
- Stiffness is set up in two levels.
- Easy to re-level if settlements occurs
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4.- TRACK CONCEPTS: SELECTION AND DESIGN

- 1st design: **3MB modular slab track system**
  Multi-Moulded Modular Blocks

RELEVANT STAGES FOR ASSEMBLY PROCESS:
- Construction of layer before laying the modules
- Installation of the modules
- Pre-installation of fastening system sets
- Fine levelling
- ‘Top-down’-like process for pouring concrete
4.- TRACK CONCEPTS: SELECTION AND DESIGN

- 2\textsuperscript{nd} design: \textbf{L-Track} modular slab track system

\textbf{INNOVATIVE FEATURES:}
- Adaptation in curves by new adjustable fastening system
- Continuous rail support and discrete fastening.
- Quick assembly on track site
- Universal module
4.- TRACK CONCEPTS: SELECTION AND DESIGN

- 2\textsuperscript{nd} design: L-Track modular slab track system

MODULAR TRACK based on a STANDARD MODULE + ADJUSTABLE FASTENING SYSTEM

A new fastening system was developed by Vossloh Cogifer allowing a Fine lateral adjustment:
- +/-6.5mm: curves are set by adjustment (for curves > 300m).
- +/-4mm for maintenance.

7 fastening systems are located on each beam.
The distance between fasteners is around 900 mm (R>3000m), and 600-700mm (R<3000m).

= AFFORDABLE TRACK DESIGN
No specific module fabrication depending on curves (radius) vs existing designs.
The “standard” concrete module can be produced with one type of mould.
The fastening system is fine adjustable without changing components vs existing designs.
4.- TRACK CONCEPTS: SELECTION AND DESIGN

- 2nd design: **L-Track** modular slab track system

VOSSLOH COGIFER
Adjustable fastening system

Vossloh Cogifer Patent pending.
4.- TRACK CONCEPTS: SELECTION AND DESIGN

- 2nd design: **L-Track** modular slab track system

**RELEVANT STAGES FOR ASSEMBLY PROCESS:**
- Construction of asphalt layer before laying the modules.
- Checking levelling
- Installation of the modules
- Installation of elastic pad and fastening elements
- Compensation and final adjustment
5.- OPTIMISATION OF THE DESIGNS

- Currently, both designs are at the prototype stage.
- Still need for lab testing and final definition.
- Testing on real-scale lab scheduled as Demonstrator in C4R.

TESTING PLAN:
- Dynamic tests with vertical loads (nominal axle load)
- Dynamic tests with vertical and horizontal loads
- Fatigue tests under vertical and horizontal loads
6.- REACHING THE COMMERCIAL STAGE

KEY STEPS:

- Optimised construction process
- Convenient cost (construction + assembly + maintenance)
- How to reach the level of proven technology in HS lines?
  - Starting by conventional lines?
  - Through deep testing in laboratory?
  - Testing section in real track? (contact to Infra Managers)
- How to achieve this in terms of investment?
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Questions?
Feedback?
Comments?

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