Capacity for Rail

INNOVATIVE SLAB TRACK CONCEPTS (generation, selection & design)

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SEVENTH FRAMEWORK PROGRAMME

v1

Contents:

Capacity for Rail

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** [*Intrinsic availability= MTBF/(MTBF+MTTR)*]

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2.- OVERVIEW OF EXISTING SLAB TRACK SYSTEMS

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

TRACK TYPE	PREVENTIVE REPARATION	CORRECTIVE REPARATION	GEOMETRIC CORRECTION
Embedded rail	Low frequency	Low frequency	Complicated
Direct support	Frequent	High frequency	Need for reconstruction
Indirect support	Frequent	High frequency	Need for reconstruction
Elastomeric coated blocks	Periodic, especially in fastening systems	Problems with water filtrations	Possible replacement of elements
Monolithic with sleeper	Periodic, especially in Fastening systems	Possible replacement of elements	Possible replacement of elements
Elastomer coated sleepers	Periodic, especially in Fastening systems	Problems with water filtrations	Possible replacement of elements
Sleepers on slab	Periodic, especially in Fastening systems	Possible replacement of elements	Possible replacement of Elements
Floating slab with Sleepers	Periodic, especially in Fastening systems	Possible replacement of Elements	Possible replacement of Elements
Slabs on non- elastic mortar	Periodic, especially in Fastening systems	Possible replacement of elements	Possible replacement of elements
Floating slabs without sleepers	Periodic, especially in Fastening systems	Possible replacement of elements	Possible replacement of elements

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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…)

3.- NEW DESIGN REQUIREMENTS AND METHODOLOGY

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

- **Construction requirements:**
  - ✓ Few construction stages
  - ✓ Fast construction and assembly
  - ✓ Modularity
  - ✓ Easy transport of prefabricated elements
  - ✓ Easy fitting to alignment

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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?

C4R Capacity for Rail → **SP1** → **WP1.1.** → **Multi-skilled team**

Collaborative workshops

Concept design of 2 alternatives

RAMS-oriented concept

LCC-oriented concept

4.- TRACK CONCEPTS: SELECTION AND DESIGN

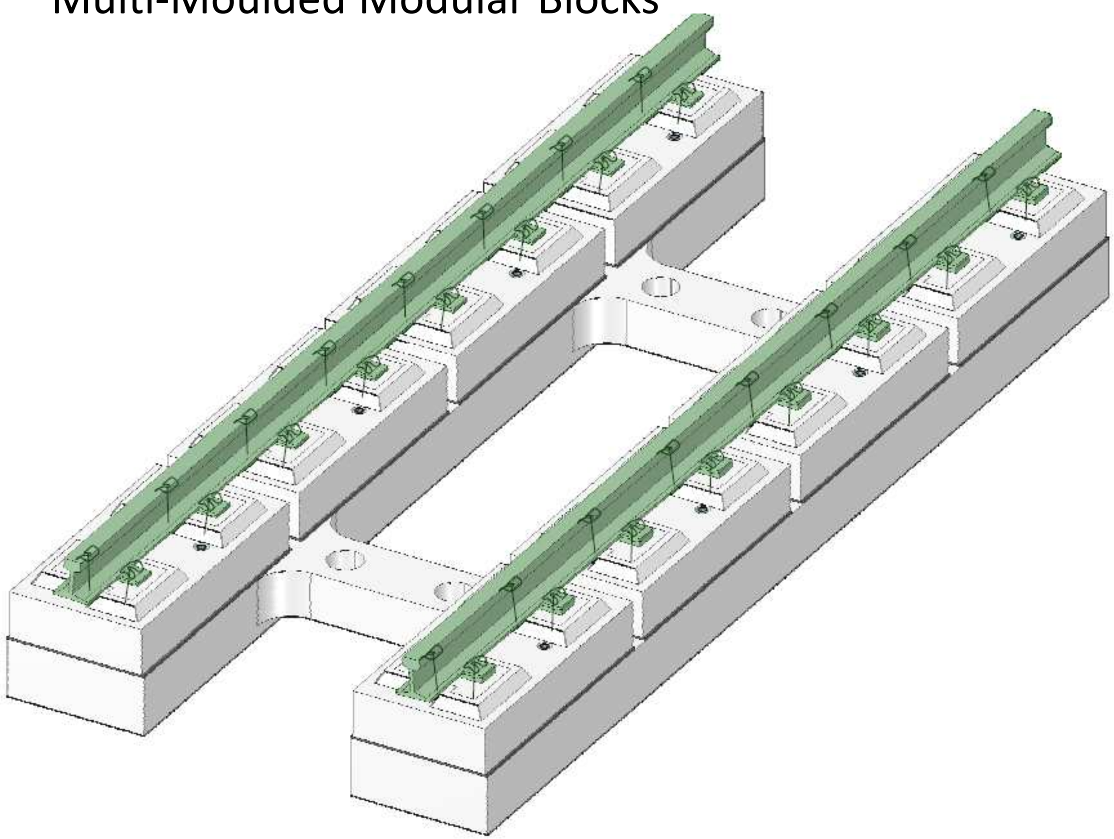
- Methodology for the design

	Studies
Structural design	Static calculation
	Stiffness levels calculation
	Dynamic calculation
	Fatigue calculation
	Digital model
	Fastenings selection
Geotechnical design	Subgrade calculation
	Drainage design
Integration	Earthing, Stray currents
	Transition zones with bridges and ballasted tracks
	Signalling equipment
RAMS and LCC	Construction process and costs
	Maintenance plan and costs
	LCC model
Business model	Business model

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 ocurrs

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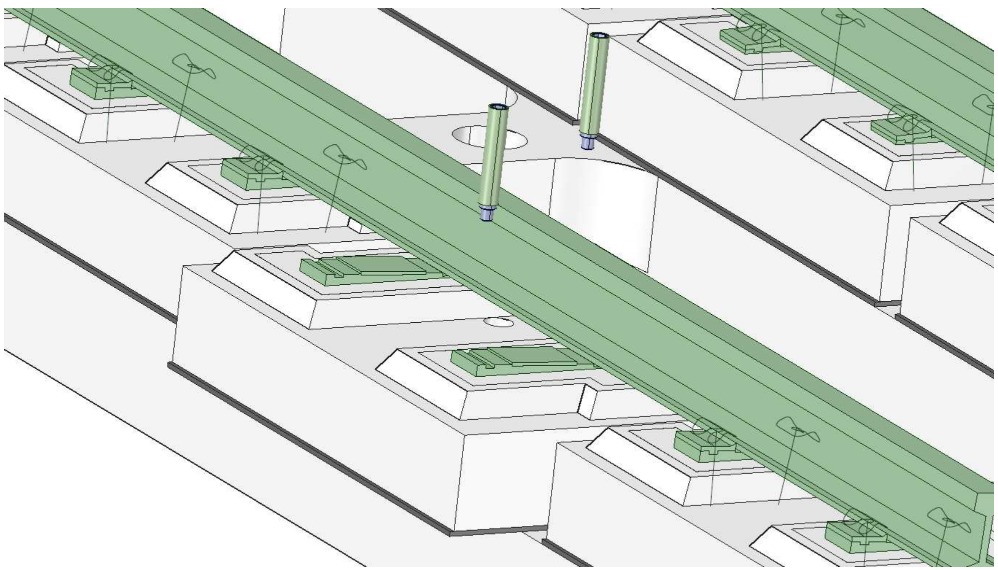

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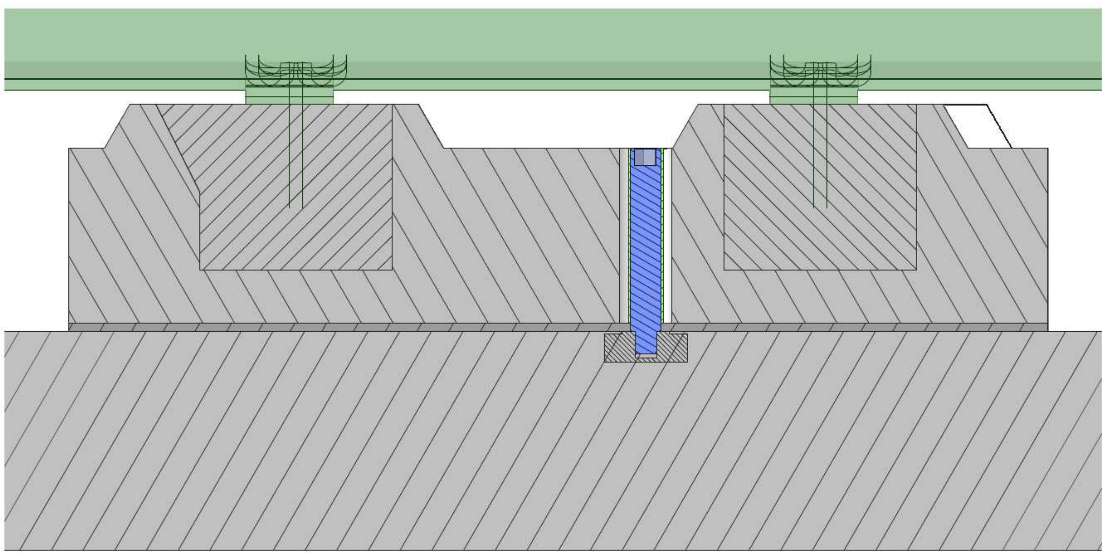

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4.- TRACK CONCEPTS: SELECTION AND DESIGN

- **1st design: 3MB modular slab track system**

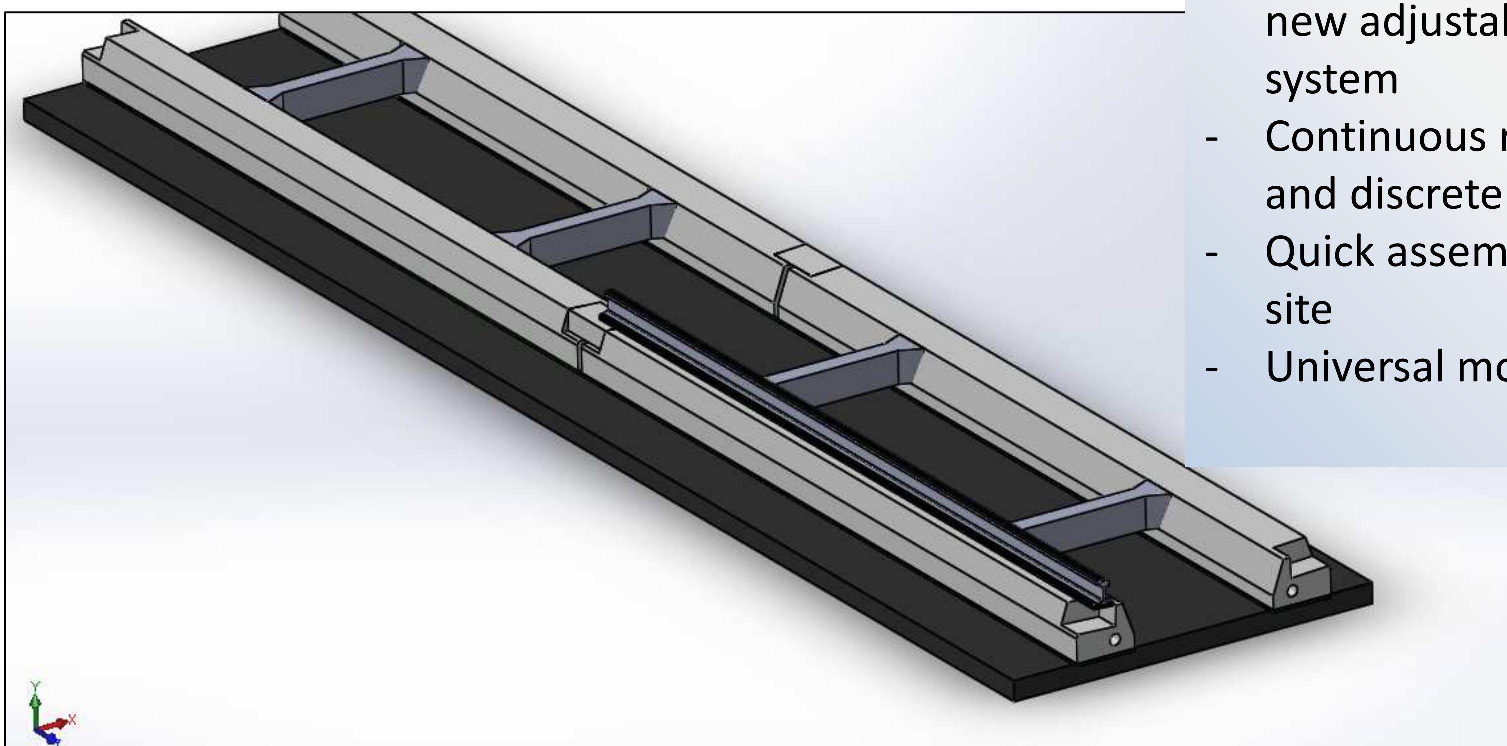
Multi-Moulded Modular Blocks

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

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

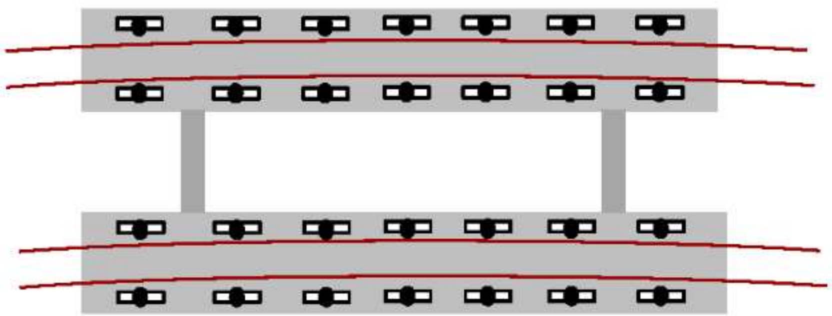


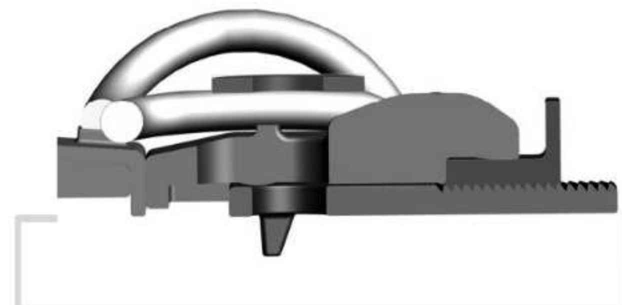
INNOVATIVE FEATURES:

- 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

- **2nd 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).

= AFORDABLE 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.

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4.- TRACK CONCEPTS: SELECTION AND DESIGN

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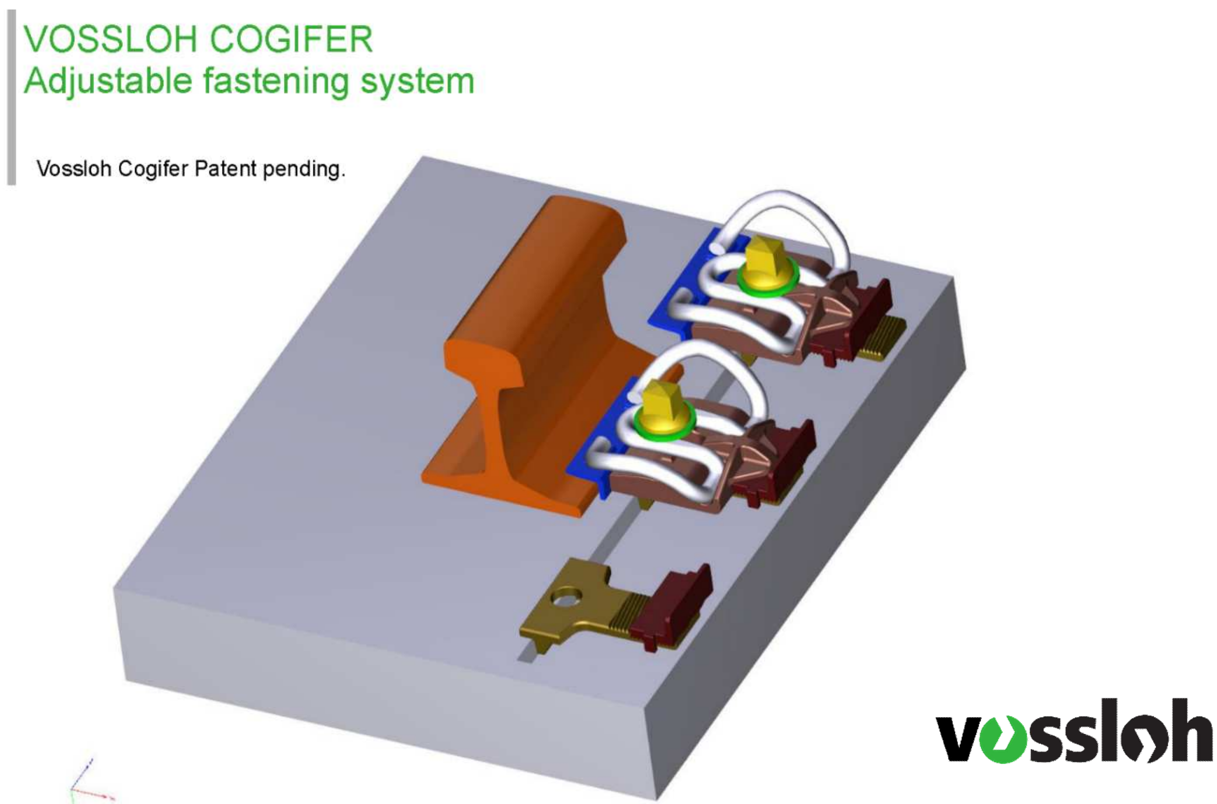

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4.- TRACK CONCEPTS: SELECTION AND DESIGN

- **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

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6.- REACHING THE COMMERTIAL 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?