

CALL FOR ABSTRACTS

TOPICS' DESCRIPTION

Disclaimer: *while research-based contributions are welcome, the primary emphasis of the congress is not on early-stage R&D, but on solutions and insights with practical value for the sector.*

Topic #1: Digital transformation of railway track maintenance

This session explores cutting-edge digital solutions for modern railway management with special focus on track maintenance. The aim is to showcase how advanced technologies enable smarter inspections, predictive maintenance and data-driven decision-making, from pilot projects to large-scale operational deployment.

Subtopics:

- a) Unmanned Aerial Vehicles, distributed fiber-optic sensing or computer vision for track inspection and monitoring
- b) Train-track dynamics and contact force applications for track maintenance
- c) Innovative solutions for improved understanding of wheel-rail contact
- d) Digital Twin and BIM implementation for track assets
- e) Early-warning systems and continuous infrastructure monitoring towards predictive maintenance
- f) Data integration platforms and interoperability for railway stakeholders

Topic #2: Digital transformation of railway structures: sensing, AI and digital twins

This session explores cutting-edge digital solutions transforming the management of railway structures (bridges, tunnels and earthworks). It focuses on how advanced sensing, artificial intelligence and digital twins enable smarter inspections, predictive maintenance and data-driven decision-making, supporting the transition from reactive to proactive asset management.

Subtopics:

- a) Digital Twin implementation for structural assets
- b) AI-driven inspection and automated defect detection

- c) Satellite-based (InSAR), Unmanned Aerial Vehicles or distributed fiber-optic sensing for either deformation and stability monitoring or structural assets inspection
- d) Advanced monitoring and early-warning systems (incl. fiber optics, DAS, IoT)
- e) Data integration platforms and interoperability for infrastructure managers
- f) From pilot projects to large-scale operational deployment

Topic #3: Advanced Rail Defect Management

Rail defects remain a major challenge for infrastructure managers, impacting safety, reliability, and costs. This session explores the latest advances in detecting, understanding, and mitigating rail defects, combining research, technology, and operational experience.

Subtopics:

- a) Inspection, monitoring and condition assessment
- b) Root causes of defect initiation and propagation
- c) Prevention and mitigation strategies
- d) Rail materials and new steel grades
- e) Best practices, operational experience and success stories

Topic #4: Risk management and performance of railway structures

This session addresses the core engineering principles governing the safety and long-term performance of railway structures, including bridges, tunnels and key structural interfaces. It focuses on understanding degradation mechanisms, structural risks and operational challenges, providing the technical foundations required for effective design, assessment and maintenance.

Subtopics:

- a) Bridge safety risks: strikes, derailments and accidental loads
- b) Fatigue, ageing and remaining life assessment of structures
- c) Tunnel safety systems and operational performance
- d) Structural behaviour and degradation in transition and interface zones
- e) Failure mechanisms and structural risk assessment approaches

Topic #5: Track Resilience to climate change and extreme natural hazards

Climate change and extreme weather events are placing increasing stress on railway track systems, affecting geometry stability, component performance, and operational reliability. This session focuses on enhancing the resilience of track infrastructure through targeted risk assessment, component-level engineering solutions, and proactive maintenance strategies.

Subtopics:

- a) Track system vulnerability and risk assessment (rails, sleepers, fastening systems, ballast, subgrade, drainage)
- b) Resilient design and adaptation of track components (sleepers, fastening systems, ballast and ballastless track solutions)
- c) Degradation and performance of track components under extreme conditions (heat, flooding, freeze–thaw, etc.)
- d) Track inspection, monitoring, and early-warning systems for climate-related risks
- e) Weather-responsive track maintenance and asset management strategies

Topic #6: Future standards and resilience of railway structures

This session focuses on the evolution of design and assessment frameworks for railway structures, addressing the transition to the 2nd Generation Eurocodes and the growing need for resilience against climate change and increasing operational demands. It explores how new standards and methodologies can support more robust, adaptable and future-proof infrastructure.

Subtopics:

- a) Implementation challenges and opportunities of 2nd Generation Eurocodes
- b) Climate resilience and adaptation of bridges, tunnels and earthworks
- c) Harmonisation initiatives and European standardisation efforts (e.g. Bridge4EU)
- d) Performance- and reliability-based design approaches
- e) Integration of resilience into lifecycle management under increasing environmental and operational loads

Topic 7#: Bridge–track interaction: integrated design and performance

This session addresses the interaction between track and supporting structures, bringing together bridge and track expertise to explore integrated design, performance and maintenance challenges. It focuses on understanding load transfer mechanisms, structural response and practical solutions to ensure safe and efficient railway operation across the bridge–track interface.

Subtopics:

- a) Principles and modelling of bridge–track interaction
- b) Load transfer and structural response under traffic, thermal and environmental effects
- c) Design solutions for ballasted and ballastless track on bridges
- d) Derailment mitigation measures design solutions
- e) Interface behavior between track and bridge structures (including transition zones)
- f) Monitoring, maintenance and practical case studies from infrastructure managers and industry

Topic #8: Railway aerodynamics

This session focuses on airflow-driven vehicle–infrastructure interaction, bringing together vehicle and infrastructure expertise to improve understanding of the underlying mechanisms and to address current operational challenges.

Subtopics:

- a) Ballast flight understanding, assessment and improved train and infrastructure design
- b) Influence of crosswind on railway operations
- c) Crossing effects between trains
- d) Drag reduction phenomena

Topic #9: Circular Economy, End-of-life assessment and CO₂ Reduction in Rail Infrastructure

Reducing environmental impact and achieving climate targets is a key priority for the railway sector. This session explores how circular economy principles can be applied across railway infrastructure, including both track systems and supporting structures such as earthworks, drainage, bridges, tunnels and retaining structures. It will focus on lifecycle optimisation, end-of-life assessment, reuse, refurbishment, recycling and low carbon solutions that enhance resource efficiency while maintaining safety, performance and resilience.

Subtopics:

- a) Application of circular economy principles (9Rs) across railway infrastructure, including track systems and components as well as bridges, tunnels, earthworks, drainage and retaining structures
- b) Service life extension, condition-based reuse and end-of-life management of railway infrastructure assets, materials and components
- c) Environmental performance and practical implementation of alternative, recycled and low-carbon materials for track systems and supporting structures (for example rails, sleepers, ballast, fastening systems, concrete, steel, geosynthetics and recycled aggregates)
- d) Lifecycle cost and environmental assessment (LCC/LCA), carbon whole-life assessment and circularity metrics to support infrastructure investment and asset management decisions
- e) Practical implementation, operational experience, barriers, lessons learned and best practice in delivering circular and low-carbon railway infrastructure