CZECH TECHNOLOGY PLATFORM

Interoperability of Railway Infrastructure

CHARACTERISTICS OF CZECH RAILWAY RESEARCH AND DEVELOPMENT

REPRESENTED BY MEMBERS OF THE TECHNOLOGY PLATFORM - UNIVERSITIES, RESEARCH AND DESIGN INSTITUTES AND RESEARCH AND DEVELOPMENT DEPARTMENTS OF INDUSTRIAL COMPANIES

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Prague, 4th October 2018

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Czech Technology Platform

Interoperability of the Railway Infrastructure

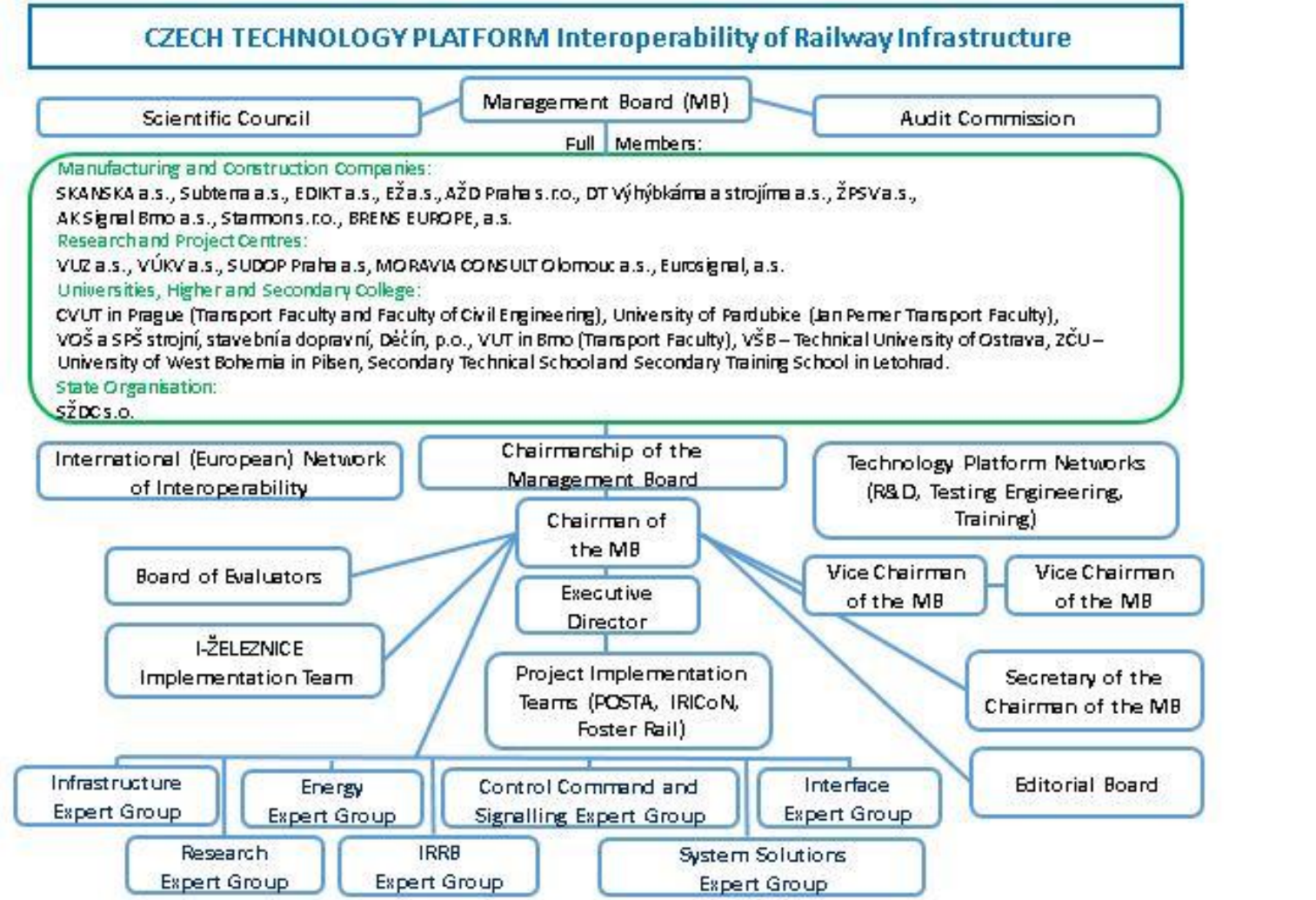
- **The main objective is to join the scientific and technical potential** of universities, research and project institutes together **with the production potential** of construction and production companies for the implementation of the following objectives and the subject of activities:
  - **Support of innovations and the increase of competitiveness** of the members of the association.
  - Support of the **implementation of research and development projects with the requirements of the technical interoperability specifications** of the Trans-European railway system in the sub-systems of infrastructure, energy, control command and signalling and interface among subsystems.
  - Acquiring of financial support for the implementation of projects.
  - The **involvement of the members of the Association into international (European) activities related to the development process of new European legislation** for construction, production and maintenance as well as related tests and the evaluation of the production of the European railway industry.

Czech Technology Platform

Interoperability of the Railway Infrastructure

- Association of **23 members:**
  - **Universities, technical college**:
    - Czech Technical University in Prague;
    - Brno University of Technology;
    - University of Pardubice;
    - University of West Bohemia
    - VSB – Technical University of Ostrava
    - Technical college Decin.
  - **Research institutes:**
    - Railway Research Institute (VUZ);
    - VÚKV (Research Institute for rolling stock).
  - **Design, contractor and industrial companies:**
    - track;
    - control command and signalling;
    - energy;
    - interface among systems.
  - **Administration:**
    - RIA (SŽDC)

Czech Technology Platform
Organizational Chart



R & D activities

- Conceptual, economic and operation starting points for high speed service in the Czech Republic:
  - synergy of long distance and regional services;
  - suggestion and justifying the need for non-traditional benefits related to the construction and use of high speed lines.
- Requirements and prerequisites for high speed operation (Track Vehicle interaction):
  - diagnostics;
  - dynamic effects;
  - aerodynamic effects in tunnels;
- High-speed rail traffic and specific maintenance requirements
  - predictive maintenance based on track- vehicle interaction;
  - use of high strength materials to reduce the maintenance demands;
  - monitoring systems.

R & D activities

- Rolling stock for high speed
  - efficient deployment of vehicles;
  - traction chain technology on high speed vehicles.
- Optimization of supply systems:
  - unifying of traction systems;
  - interaction of power supply system with power network;
- New design solutions for high speed railway infrastructure:
  - a new generation of switches & crossings;
  - development and verification of S&C structures for high speed
  - new generation of materials
- Control and command systems:
  - on-track;
  - on-board and related operational requirements.

R & D activities

- Support of priority programs in R & D - financing options:
  - European programs (Horizon2020, Shift2Rail);
  - National resources – Technology agency of the Czech Republic (TAČR), Railway Infrastructure Administration (SŽDC), Czech Science Foundation (GAČR);
  - contract research – railway industry.
- Selection of National Projects - TAČR Competence Centres (2012-2019):
  - Centre for Effective and Sustainable Transport Infrastructure (CESTI)
  - Competence Center of Railway Vehicles (CKDV)

Centra kompetence

CESTI centre for effective and sustainable transport infrastructure

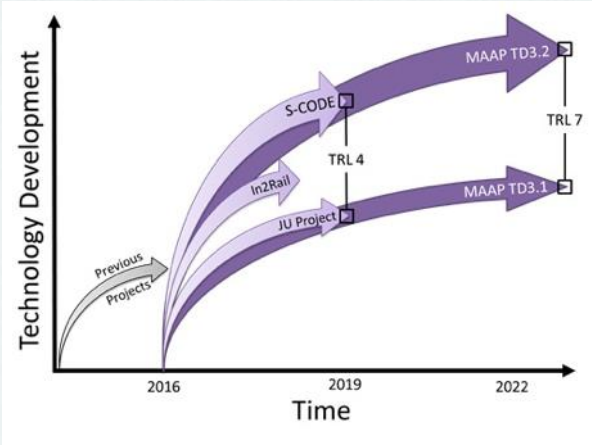
CKDV Centrum kompetence drážních vozidel

SHIFT2Rail Projects

- IP2
  - X2Rail 1 – Start-up activities for Advanced Signalling and Automation Systems
  - X2Rail-2 Enhancing railway signalling systems based on train satellite positioning, on-board safe train integrity, formal methods approach and standard interfaces, enhancing Traffic Management System functions
  - ETALON
  - VITE Virtualisation of the testing environment
- IP3
  - S-CODE – Switch and Crossing Optimal Design and Evaluation
- IP4
  - GoF4R Governance of the Interoperability Framework for Rail and Intermodal Mobility
  - ST4RT Semantic Transformations for Rail Transportation
- IP5
  - INNOvative monitoring and predictive maintenance solutions on lightweight WAGon
  - OptiYard - Optimised Real-time Yard and Network Management

SHIFT2Rail Projects

- S-CODE – Switch and Crossing Optimal Design and Evaluation:
  - S2R-OC-IP3-01-2016, from 01/11/2016 to 31/10/2019, € 45.003.870,33
  - The overall aim of the S-CODE project is to investigate, develop, validate and initially integrate radically new concepts for switches and crossings that have the potential to lead to increases in capacity, reliability and safety while reducing investment and operating costs;
  - coordinator – University of Birmingham, the Czech partner: DT Výhybkárna a strojírna, a.s., Brno University of Technology, University of Pardubice
  - http://www.s-code.info



Shift2Rail S-CODE

- Work on the project began in November 2016, with partners collaborating to find approaches to achieve the following challenging targets:
  - Self-inspecting, self-correcting and healing unit which contributes towards a 50% improvement in the reliability and availability of switches
  - Realization of new movement principles to contribute towards a reduction in the life cycle cost of switches by up to 30%
  - Capacity improvement of up to 100%
  - Fail safe locking mechanism

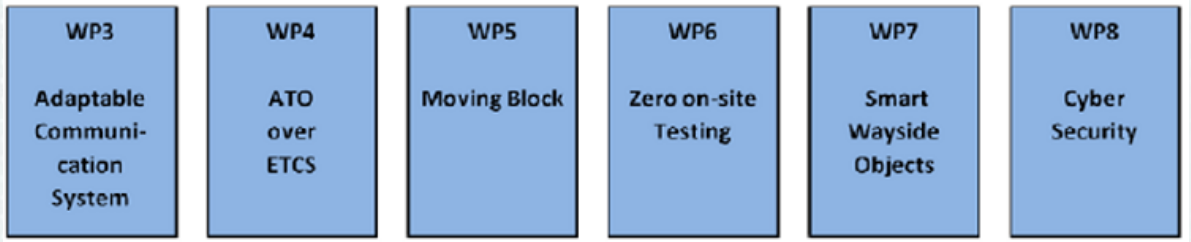
SHIFT2Rail Projects

- ETALON:
  - S2R-OC-IP2-02-2017, from 01/09/2017 to 31/01/2020, € 2 000 000
  - The objective of the project “ETALON” is the adaptation of energy harvesting methodologies for trackside and on-board signalling and communication;
  - coordinator – UNIFE, the Czech partner: Brno University of Technology
  - http://www.etalon-project.eu/home.aspx

SHIFT2Rail Projects

X2RAIL 1

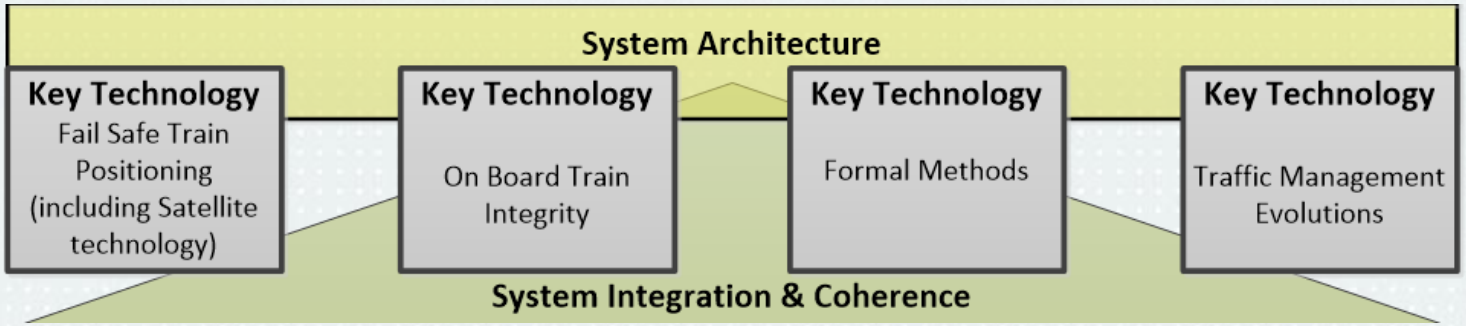
- X2Rail 1 – Start-up activities for Advanced Signalling and Automation Systems:
  - S2R-CFM-IP2-01-2015, from 01/09/2016 to 31/08/2019, € 45.003.870,33
  - the X2Rail-1 project aims to research and develop six selected key technologies to foster innovations in the field of railway signalling and automation systems towards a flexible, real-time, intelligent traffic management and decision support system;
  - coordinator – SIEMENS, the Czech partner: AŽD Praha
  - http://projects.shift2rail.org/s2r_ip2_n.aspx?p=X2RAIL-1



SHIFT2Rail Projects

X2RAIL 2

- X2Rail-2 Enhancing railway signalling systems based on train satellite positioning, on-board safe train integrity, formal methods approach and standard interfaces, enhancing Traffic Management System functions :
  - S2R-CFM-IP2-01-2017, from 01/09/2017 to 31/08/2020, € 30 152 828,03
  - X2Rail-2 aims to improve the performance at a railway system level by introducing new functionalities at sub-system level as well as on the architectural level that should revolutionize the signalling and automation concept for the future;
  - coordinator – ANSALDO STS S.p.A., the Czech partner: AŽD Praha
  - http://projects.shift2rail.org/s2r_ip2_n.aspx?p=X2RAIL-2



SHIFT2Rail Projects

- INNOvative monitoring and predictive maintenance solutions on lightweight WAGon:
  - S2R-OC-IP5-03-2015, 01/11/2016 to 30/04/2019, € 1 500 562,50
  - The aim of INNOWAG is to develop intelligent cargo monitoring and predictive maintenance solutions integrated on a novel concept of lightweight wagon, which responds to major challenges in rail freight competitiveness, in relation to the increase of transport capacity, logistic capability and an improved RAMS and lower LCC;
  - coordinator – University of Newcastle Upon Tyne, the Czech partner: VUZ
  - http://newrail.org/innowag/

SHIFT2Rail Projects

- New calls – project proposals:
  - S2R-OC-IP2-01-2018 – Analysis of moving block and concept implementation of virtual connection (VUZ);
  - S2R-OC-IP3-01-2018 – Measuring and monitoring devices for railway assets Asset4Rail (VUZ)
  - S2R-OC-IPX-01-2018 – Vehicle Based Switching (Brno University of Technology)
  - S2R-OC-IP3-01-2018 – InMODE4Rail (Brno University of Technology)

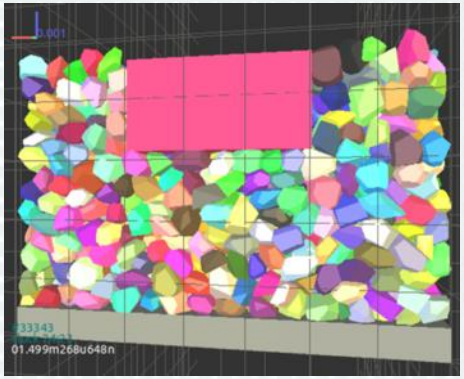
TACR Centre of competence

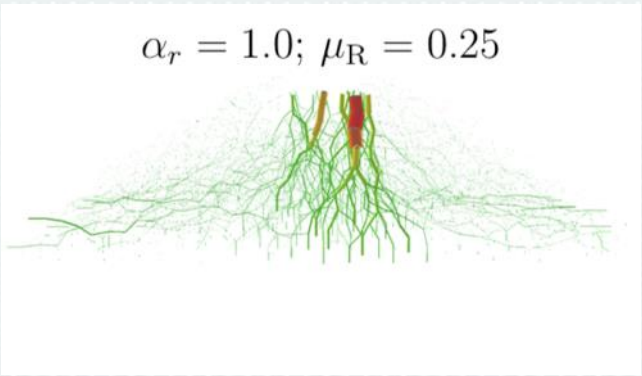
- Centre for Effective and Sustainable Transport Infrastructure (CESTI)
- Consortium of 23 partners:
  - R&D institutes: Czech University of Technology in Prague, Brno University of Technology, Centre of Transport Research
  - Railway Industry
  - Contractors
- Strategic research agenda:
  - WP2 Technical, Technological and Cost Aspects of Infrastructure of Railway Tracks and City Rail System
  - Main objective is to join railway industry companies, contractors and research bodies to further develop infrastructure of railway tracks and city rail systems to fulfill higher demands concerning increased speed, load, safety, security and availability and at the same time economic and environmental demands.

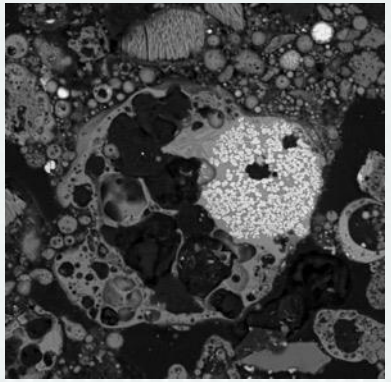
TACR Centre of competence

CESTI Center for Sustainable and Effective Transport Infrastructure

- Static and dynamic analyses of railway structures, modelling of structures and elements of tracks, e.g.:
  - requirements on parameters of static and dynamic analyses
  - advanced numerical model of railway ballast bed is under development
  - mathematical model of a dynamic system, description of the effect of relative damping and critical velocity on deflections of the track
  - monitoring of track sections with under sleeper pads
  - analysis of rail pitch corrugation development in curves of small radius



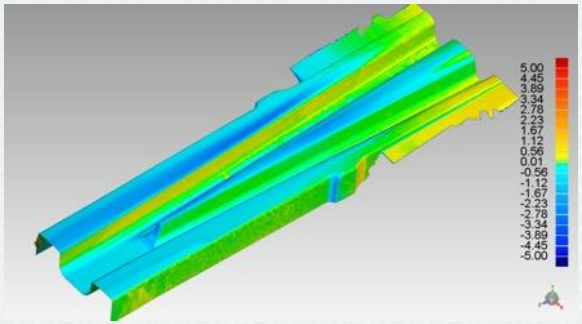




TACR Centre of competence

CESTI Center for Sustainable and Effective Transport Infrastructure

- DT: Switches & Crossings for high speed
  - new actuating and locking device;
  - laboratory test of rail fastening systems;
  - laser scanning and monitoring of crossings wear;
  - S&C for slab track structures



R & D Facilities

- Regional Research Centres
  - AdMaS Advanced Materials, Structures and Technologies – Brno University of Technology
  - Educational and Research Centre in Transport – University of Pardubice
  - UCEEB University Centre for Energy Efficient Buildings – Czech Technical University in Prague
- Výzkumný ústav železniční, a.s. (Railway research institute, VUZ)
- VUKV (Research, development and testing of railway rolling stock)

AdMaS
ADVANCED MATERIALS, STRUCTURES AND TECHNOLOGIES

BRNO UNIVERSITY OF TECHNOLOGY
FACULTY OF CIVIL ENGINEERING

Research Centre in Civil Engineering

www.admas.eu

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EUROPEAN REGIONAL DEVELOPMENT FUND
INVESTING IN YOUR FUTURE

OP Research and Development for Innovation

AdMaS - complex research institution

AdMaS
ADVANCED MATERIALS, STRUCTURES AND TECHNOLOGIES

Acronym: **Ad**vanced **Ma**terials, **S**tructures and Technologies

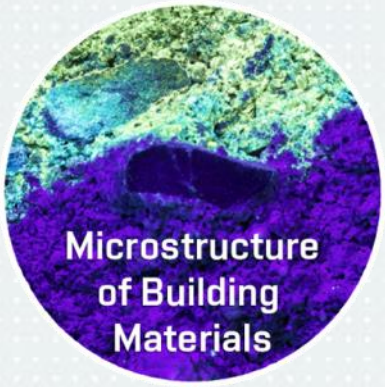
Modern **science centre** and complex research institution in civil engineering

Affiliated to the **Faculty of Civil Engineering**, Brno University of Technology

Research, development and application of advanced building materials, structures and technologies

Successful long-term **cooperation** with private and public sphere

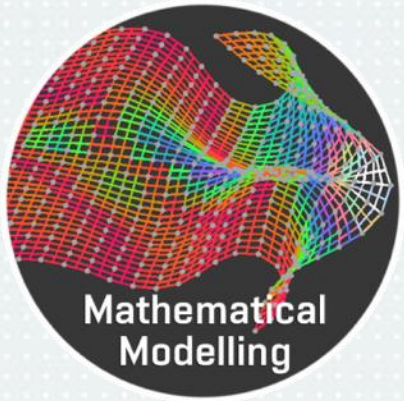
Structure of AdMaS Centre



Development of Advanced Building Materials

AdMaS
ADVANCED MATERIALS, STRUCTURES AND TECHNOLOGIES

Development of Advanced Structures and Technologies

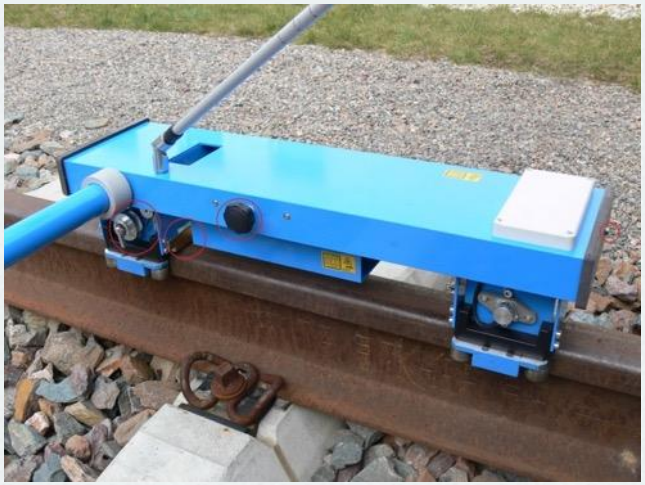


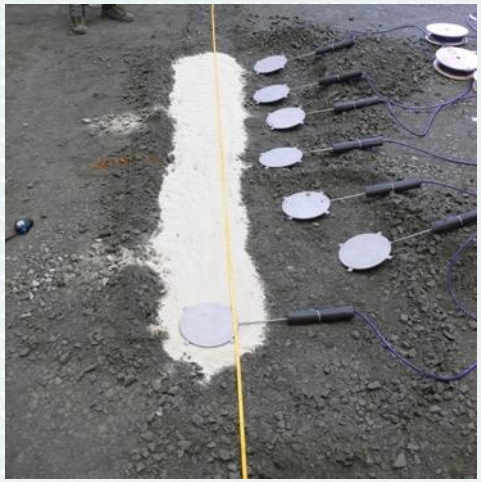
BRNO UNIVERSITY OF TECHNOLOGY
FACULTY OF CIVIL ENGINEERING

Structural and Transport Engineering

Railway Infrastructure

Analysis and long-term evaluation of the rail roughness and rail corrugation development, monitoring of track quality, assessment of dynamic effects





Electrohydraulic and pneumatic test systems

- A suite of test devices used in the full-scale testing of structural details, elements and components.
- Measurement and evaluation systems for static and dynamic measurements

Microstructure of Building Materials

X-Ray Tomography Scanner

- Study of the structure of substances in 3D
- Monitoring of macroscopic cracks and other discontinuities in materials.

X-ray diffraction system with Rietveld refinement

- Determination of the phase content of materials with the aid of X-ray diffraction analysis
- Analysis of phase changes in materials during heating up to a temperature of 2000° C, and during cooling.

Scanning Probe Microscope

- Microscopic analysis of the microstructure of substances at extreme resolutions (up to 80 000x)
- Determination of the elemental composition of studied objects (e.g. crystals) with the aid of an elemental probe.

Educational and Research Centre in Transport – University of Pardubice

- Centre for developing educational and research activities of the Jan Perner Transport Faculty
- Utilization of the most advanced available equipment in the field of transport structures and transport means
- Development of multi-disciplinarity of creative and educational activities in the technical and technological branches in the field of material engineering

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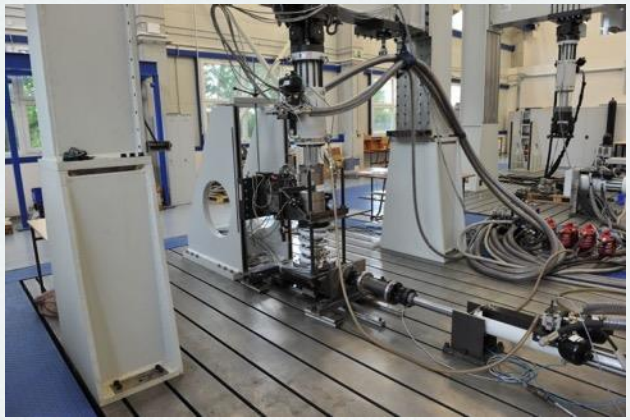
OP Research and Development for Innovation

Educational and Research Centre in Transport – University of Pardubice

- **Equipment**:
  - laboratory equipment for transport structures and transport means material engineeering, hydraulics and electric engineering,
  - dynamic test stand
  - press for bending and strenght tests
  - folding platform for vehicles
  - instrumented impact hammer
  - dynamometer

https://dfjp.upce.cz/en/jptf/erct



UCEEB University Centre for Energy Efficient Buildings – Czech Technical University in Prague

- Architecture and the environment
- Energy systems in buildings
- Quality of indoor environment
- Materials and structures
  - Mechanical Laboratory
  - Laboratory of Electron Microscopy and Microanalysis
- Control and monitoring of intelligent building

http://www.uceeb.cz/en

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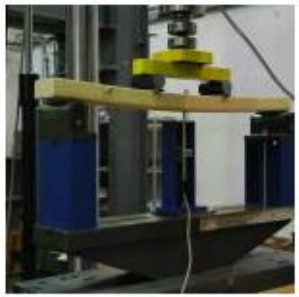
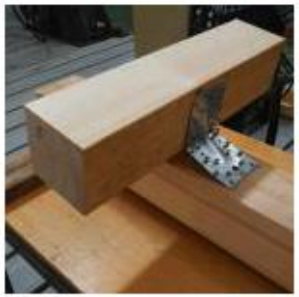
INVESTING IN YOUR FUTURE

2007-13
OP Research and Development for Innovation

UCEEB University Centre for Energy Efficient Buildings – Czech Technical University in Prague

- Materials and structures
  - Ultra high-resolution FEG scanning electron microscope with EDS, WDS and EBSD detectors, including an extensive database of crystallographic data
  - Argon ion milling machine and ion ultramicrotome
  - Optical polarising microscope with a set of EC PlanNeo-fluar lenses for both and reflected and transmitted light
  - High-definition 3D binocular microscope
  - Automated lapping machine for preparation of polished sample surfaces and thin sections and a cutting machine for solid material samples
  - Nanoindentor with on-line thermal load control


VUZ – Railway Research Institute

- Testing
  - Test Center Velim
  - Railway test rings
  - Accredited testing laboratory
  - Dynamic test laboratory
    - strength tests and analysis of construction stress under simulated loads
    - measuring of damping and spring elements characteristics
    - functional tests of engines and equipment– verification of functionality under load or overload
    - frequency and dynamic characteristics of components and systems of machines
    - and vibration tests
- Notified Body
- Training Centre

VUKV

Research, development and testing of railway rolling stock

- Development
  - complex solutions of development projects from the opening study via the design, construction, preparation of drawing documentation and cooperation in manufacture of prototypes, to approval and launch of operation
- Test Centre
  - static tests at its facilities or on-site at a customer location and dynamic tests on the operator's track or on various test tracks
- Assessment
  - qualified expert assessment, advisory and consultancy services

Conlusion

- TP supports the R & D activities of its members for the high speed railway system
- Czech universities, research institutes, companies of railway industry, design companies, railway infrastructure administration are implementing R & D projects on topical issue of railway high speed system
- TP actively supports conclusions of the FosterRail project
- TP and its members follows ERRAC Rail Visions 2050
- TP is ready to cooperate with partners from whole Europe and offers its highly professional capacities of Expert Groups and constituted networks.

Thank you
for your attention