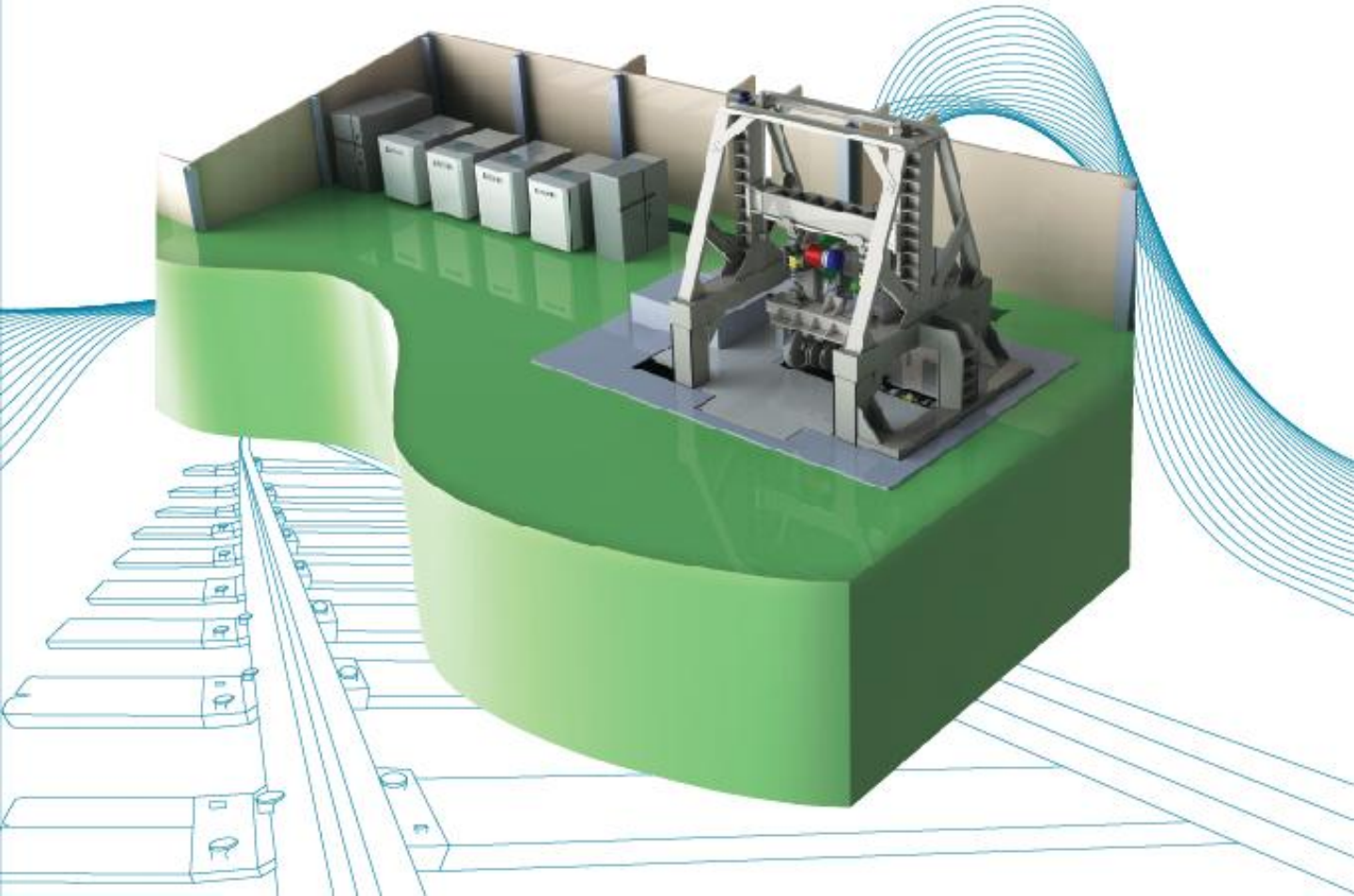
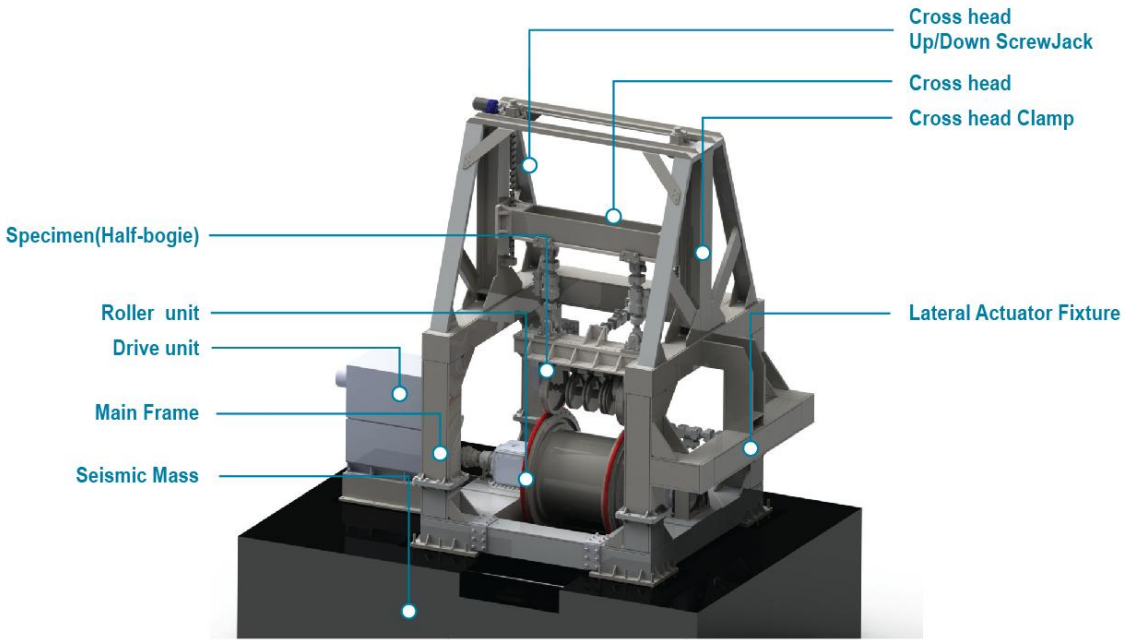
High Speed Train Derailment Simulation System

Derailment simulation system is specifically designed to reproduce as close as possible the actual running condition that are normally experienced by a railway wheelset in standard operation and in emergency conditions. The system is used to test wheelsets in full scale under realistic running conditions, representative of vehicle service in tangent track and curve. To aim this, actuators are used to apply on the wheelset forces in vertical and lateral direction, and additionally to produce an angle of attack by yawing the wheelset with respect to the roller.

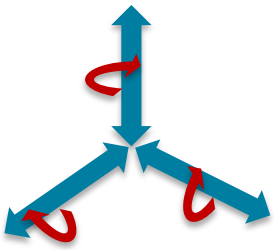


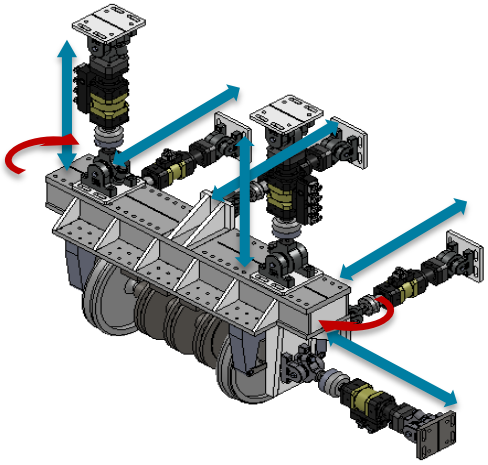


The system is composed by 2 rigidly coupled rollers having a diameter 2100mm and bearing two rail rings with rail profile; the rollers are driven by AC servo-motor. The rail rings are made of a special steel grade, enhanced resistance to wear, to reduce maintenance of the rollers associated with the re-profiling or replacement of the rails.
The wheelset leans on the top of the roller and is connected by primary suspensions with a transverse beam, called hearafter 'half-bogie'.

Specification

Specimen	Specimen speed		330 km/h
	Wheel diameter		500 ~ 2,000 mm
	Max. estimated weight of wheelset and cross-bar		approx. 7 ton
Roller unit	Roller diameter		2,100 mm
	Track width		1,435 mm
	Max. roller speed		330 km/h
	Balancing quality (VDI 2060)		Q 2.5
	Roller brake		8,000 Nm
Drive unit	Power		762 kW
	Max. speed		1,250 rpm
	Torque (@488 rpm)	reted	15,146 Nm
		overload	27,262.8 Nm

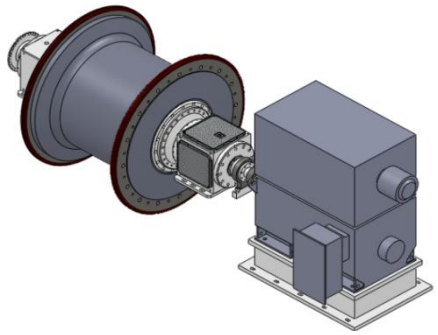




The actuator system is composed by two vertical actuators, one lateral actuator, and three longitudinal actuators. The vertical actuators are mounted over the half-bogie. They are used to apply vertical forces on the two wheels to produce the static axle load, quasi-static load transfer from the inner to the outer wheel in a curve, and dynamic overloads produced by vehicle dynamics. The lateral actuator is used to apply lateral quasi-static loads associated with curve negotiation and dynamic overloads produced by vehicle dynamics. The three longitudinal actuators are used to apply a yaw rotation of the half-bogie, including an angle of attack of wheelset over the roller.

Performance Specification

2x Vertical actuator	Capacity	static load	± 200 kN
		dynamic load	± 150 kN
	Performance	at 2.5 Hz	± 30 mm
		at 5 Hz	± 15 mm
	Max. displacement		± 50 mm
	Working pressure		210 bar
1x Lateral actuator	Capacity	static load	± 150 kN
		dynamic load	± 100 kN
	Performance	at 2.5 Hz	± 21. mm
		at 5 Hz	± 10 mm
	Max. displacement		± 50 mm
	Working pressure		210 bar
3x Longitudinal actuator	Capacity		± 90 kN
	Max. yawing angle (at 50 mm stroke)		± 2.4 °
	Performance	at 1 Hz	± 44 mm
		at 8 Hz	± 5. mm
	Max. displacement		± 50 mm
	Working pressure		210 bar



The Drive unit is composed by the AC servo-motor and telemetry type torque transducer. The AC servo-motor is operated in speed control mode with the maximum capacity of 762 kW and the maximum vehicle speed of 330 km/h. The torque transducer is used to measure motor torque associated with process of vehicle acceleration or braking. The type of torque transducer is an advanced telemetry type, it can reduce maintenance cost.

The Roller unit is composed by 2100mm diameter roller, two high reliable spindles with oil lubrication device and water cooling jackets, and one emergency brake. The roller has two rail rings those have realistic rail profile. For the maintenance and easy to change the rings, the mounting system between roller and spindles is specifically designed to easily disassemble.

The control system diagram is clearly visible in right side figure. The Deneb series, a multi axial digital controller, can control up to 8 axis and it shows the accumulated experience and technology of KNR. Basically it has a 1kHz of control loop and it communicates in real time between sensors and using LAN for the server communication.

KNR uses its proven dynamic system controlling software, Sabio-DE and it has a supplementary module for safety features.

The number of sensors for temperature and acceleration is for high speed rotational roller and spindle which are examples of the safety features. Moreover, this software checks each hydraulic servo actuator's displacement and load limit and additionally, it measures the relative distance between half bogie wheel and roller rail rings and checks the wheel flange climbing derailment.

Typical tests carried out on this system

To measure the stability of railway vehicles To study wheel/rail interactions To simulate the vibration of vehicles running on track with different irregularity conditions To simulate the process of train acceleration or braking

Diagram of Control System