

## CEDEX Track Box (CTB)

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Owner: CEDEX-Laboratorio de Geotecnia

Location: Madrid, Spain

### Key Technical Specifications

CEDEX Track Box	
Manufacturer	CEDEX
Year established	2004
Physical dimensions	21 m (length) x 5 m (width) x 4 m (depth)
Capacity	Reproduce speed trains up to 400 km/h Reproduce passenger and freight trains
Major equipment	3 pairs of servo-hydraulic actuators (250kN and 50 Hz) 2 piezoelectric actuators (20kN and 300Hz) Numerous sensors to measure: displacement, pressure, velocity and acceleration from railway track section (embankment, ballast, subballast, form layer) and superstructure (sleeper, rail, pad)

### Description

CEDEX Track Box (CFC) is a 21 m long, 5 m wide and 4 m deep facility whose main objective is to test, at 1:1 scale, complete railway track sections of conventional and high-speed lines for passenger and freight trains, at speeds up to 400 km/h. Figure 1 shows a general view of the testing facility.

The testing facility was designed, built and developed as part of SUPERTRACK ("Sustained Performance of Railway Tracks", 2001-05) and INNOTRACK ("Innovative Track Systems", 2005-2009) projects funded by the European Union Fifth and Sixth Framework Programs, respectively.

Its principal advantage is the possibility of performing fatigue tests in a fast way as in one working week, the effect of the passing-by of trains during a year in a real section can be modelled. The reproduction of the effect of an approaching, passing-by and departing train in a test cross-section, as it occurs in a real track section, is performed by application of loads, adequately unphased as a function of the velocity of the train which is being simulated, produced by three pairs of servo-hydraulic actuators. These actuators can apply a maximum load of 250 kN at a frequency of 50 Hz and are placed on each rail separated 1,5 m longitudinally, as seen in Figure 2 (left). Furthermore, the reproduction of wheel and track imperfection effects that produce low amplitude high-frequency dynamic loads can also be carried out by the use of two piezoelectric actuators that can apply loads up to 20 kN at 300 Hz, as seen in Figure 2 (right). The railway track response, in terms of displacements, velocities, accelerations and pressures, is collected from a great number of linear variable differential transformers (LVDTs), geophones, accelerometers and pressure cells installed inside both the embankment and the bed layers (ballast, sub-ballast and form layer) of the track. Figure 3 (left) shows a cross-section of the testing facility with the position of the sensors used in one of the tests. On the other hand, the railway superstructure response is recorded with mechanical displacement transducers, laser sensors, geophones and accelerometers installed on the different

track components (rail, sleeper and rail pad), as seen in Figure 3 (right). The acquisition data unit can receive information from 150 sensors at the same time



Figure1. General view of CEDEX Track Box

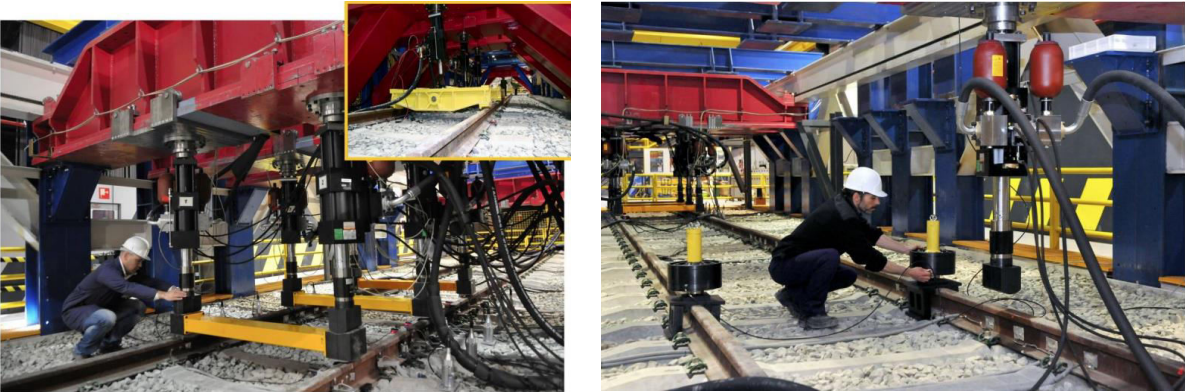


Figure 2. Loading system formed by three pairs of hydraulic actuators (left). Piezoelectric actuators to simulate track imperfections (right).

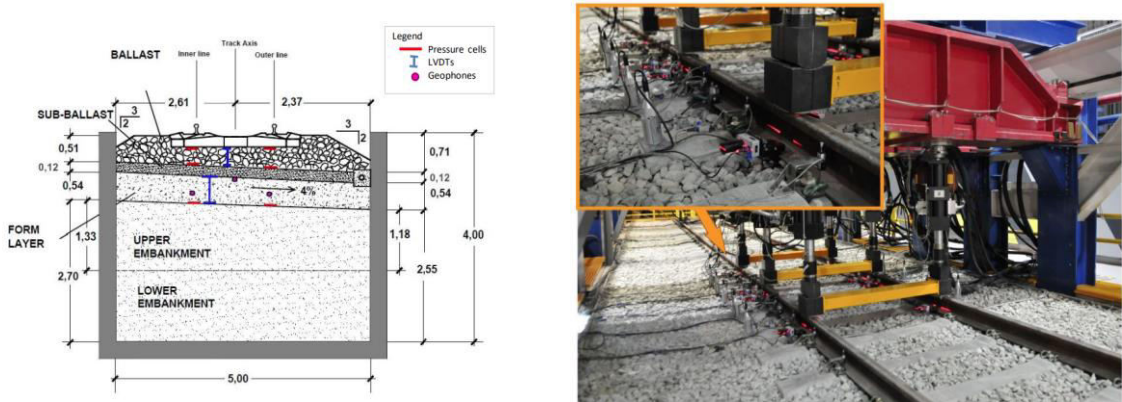


Figure 3. Schematic cross-section of CTB (left). Surface instrumentation installed for one test (right).

**Applications**

CEDEX Track Box, as testing facility, allows the performance of different kinds of tests on 1:1 scale models of track sections with different characteristics.

Characteristics of the 1:1 scale models

The 1:1 scale models that can be built in CTB can have the following features:

- Tests on ballasted or slab tracks.
- Tests on sections in straight line or in curve.
- Tests on switches and crossings.
- Tests on transitions zones.
- Tests with different kinds of ballast, subballast, form layer or embankment.
- Tests with standard, polyvalent and three-rail sleepers.
- Tests with new materials: sleepers with USP, under ballast mats, artificial ballast, bituminous subballast, soils reinforced with geotextiles and soils treated with lime or cement.

#### Kind of tests to be performed

The tests that can be performed in CTB can have the following features:

- Tests with passenger and freight trains.
- Tests with static loads to determine track stiffness.
- Tests with quasi -static loads to simulate the pass-by of trains at speeds up to 420 km/h.
- Tests with dynamic loads to simulate the effects induced by track irregularities.
- Test to determine the fatigue behaviour of any track component (mainly, fastening system, ballast, subballast) by the simulation of pass-by of millions of axle trains.
- Tests to reproduce the effect of tamping operations on ballast degradation, with a small size tamping machine.
- Tests on vibration propagation.
- Tests to determine the lateral and longitudinal track resistance, with a specifically dsigned equipment

#### Analysis of results

The test results can be used to:

- Analyze the short and long term behaviour of railway track sections submitted to any kind of train traffic and
- Calibrate 3D numerical models to be used in other type of studies or to widen the aim of the tests.

#### Other tests Additionally

Laboratorio de Geotecnia – CEDEX has a Soil and Rock Mechanic Laboratory, fully equipped with large test devices, situated in the same location. The following tests can be performed in its facilities:

- Geomechanical tests on ballast, subballast and other ground materials.
- Tests of the sleeper-ballast contact.
- Mechanical tests on elastomeric materials