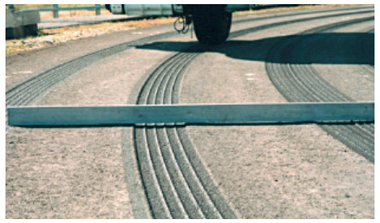
Fields of application of the pavement fatigue carrousel

Accelerated tests conducted on the pavement fatigue carrousel allow to evaluate in few months the durability of construction solutions usually planned to last approximately from 20 to 30 years.

Among the numerous applications :

- Assessment of innovative pavement materials and structures (fatigue, rutting, cracking…)
- Assessment of pavements maintenance and reinforcement methods
- Study of the aggressiveness of traffic loading and urban transports (on tires) like guided buses
- Influence of the water content on the behavior of soils and unbound materials
- Validation of constitutive models and design methods for pavements
- Evolution of the service properties of pavements with respect to traffic (evenness, skid resistance)
- Study of the behaviour and design of specific road elements: pavement structures for tramways, culverts, manhole covers, trenches…
- Assessment of instrumentation and pavement monitoring equipment

Cracking of a rigid pavement



Rutting of a pavement structure (guided traffic)

Testing of resistance to traffic of manhole covers

Testing of tramway structures

We are already working together

French General Directorate for Infrastructures, Transport and the Sea (MEDDE- DGITM)

ASFA (Association of French motorway companies)

Road construction companies : EIFFAGE, EUROVIA, COLAS-SCREG, EGIS

Concrete pavement manufacturers, cement producers : SPECBEA (Syndicat Professionnel des Entrepreneurs de Chaussées en Béton et d'Equipements Annexes),

SFIC (Syndicat Français de l'industrie cimentaire)

Material producers : SHELL, TOTAL, BP, UNPG (Union of aggregate producers)

Transport companies, manufacturers of road equipment, etc : ALSTOM, BOMBARDIER, SAINT-GOBAIN, GAZ DE FRANCE, TENSAR, RATP, 6D SOLUTIONS, CNET Lannion

MTQ (Ministry of Transport of Québec)

ANR (French National Research Agency) : Projects RECYROUTE, SOLDUGRI

European projects : OPTEL, TROWS , FORMAT

OECD : FORCE project (First OECD Road Common Experiment)

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French institute of science and technology for transport, development and networks

IFSTTAR

A major facility of Ifsttar :

The pavement fatigue carrousel

A major accelerated pavement testing facility

The fatigue carrousel of Ifsttar is a road traffic simulator designed to study the behavior of real scale pavements under accelerated heavy traffic. In operation since 1984, the carrousel has been used for more than one hundred pavement tests, performed in collaboration with the road industry.

The fatigue carrousel has a diameter of 40 m and 4 loading arms which can each carry loads up to thirteen tons, at speeds reaching 100 km/h. Two months of testing can represent up to 20 years of heavy traffic undergone by a moderate traffic pavement (T3 : 150 heavy truck/day). The experiments may concern evaluation of new pavement structures, pavement maintenance and reinforcement techniques, as well as evaluation of various types of road equipment. The dimensions of the carrousel allow to use standard roadwork equipment for pavement construction.

The carrousel

The fatigue carrousel is composed of a central motor unit and of four arms carrying the moving loads. Each arm can be equipped with different types of wheels, reproducing usual heavy vehicle axle configurations (simple or twin wheels attached to simple, tandem or tridem axles).

Single wheel

Twin wheels

Tandem axle with twin wheels

Tridem

The carrousel's arms are supported by intermediate wheels, placed at mid-length of each arm, rolling on a reinforced concrete ring. The running gears at the end of the arms are equipped with an original low stiffness suspension system, which allows to maintain a constant load, whatever the level of damage of the structure. To simulate the transversal wandering of traffic, the loads can move laterally during the rotation of the carrousel.

The test tracks

Aerial view of the three test tracks

Concrete lining with groundwater control system

The test site comprises three circular test tracks. The carrousel can be transferred from one ring to another in less than a week. The average radius of the tracks is 17.5 m and the pavement width is 6 m. It is possible to anchor the undercarriages at different distances along the carrousel arms (going from 15.5m to 19.5m), thus changing the radius of rotation. The average perimeter of a track is 120 m. Usually, each track is divided into several test sections (typically 20 to 30 m long), which are tested simultaneously.

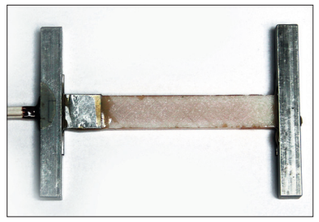
One of the rings is equipped with a water-tight concrete lining (3 m deep and 10.4 m wide), filled up with clayey sand. A pumping system allows to control the level of the groundwater in the subgrade soil , and to vary this level during the tests, to simulate seasonal moisture variations.

Pavement construction

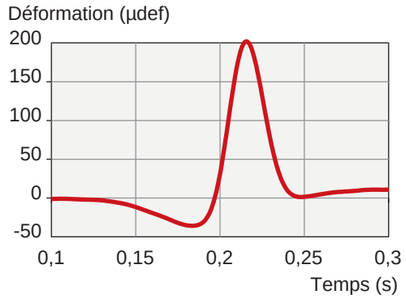
Usual roadwork equipment is used for the construction of the experimental pavements (the materials are manufactured in plants of the Nantes area, and spreading and compaction is performed as on real construction sites).

Instrumentation and monitoring of the pavements

The tested pavements are instrumented in order to follow their evolution. The measured parameters generally include: pavement deflection, longitudinal and transversal strains in bound pavement layers, vertical stresses and strains in unbound pavement layers and in the subgrade, and pavement temperatures. Other sensors may be used for specific applications: accelerometers, geophones, water content probes, tensiometers. The data acquisition system is designed to collect up to 256 measurement channels.



Strain gauge



Example of a longitudinal strain signal measured by a gauge under a passing of twin wheels

Vertical strain gauge for unbound granular materials

FWD (Falling Weight Deflectometer)

Visual assessment and non-destructive testing techniques are also used to monitor the pavements during the experiments. Common tests include deflection measurements using the Benkelman beam, transversal and longitudinal profile measurements, crack monitoring, FWD (Falling weight deflectometer) tests and GPR (Ground Penetrating Radar) measurements. All types of pavement monitoring equipment may be used due to the large dimensions of the fatigue carrousel.

Key characteristics

Engine Power : 1000 hp
Load of a single wide wheel : 45 kN
Loads of twin wheels : 65 kN
Loads of tandem with single / twin wheels : 90 kN / 130 kN
Loads of tridem with single wheels : 135 kN
Maximum speed at R = 19 m : 100 km/h
Maximum daily traffic : 55 000 loads (at 70 km/h)
Transversal wandering : +/- 52 cm