IMT Strip 1 – PowerCem

PowerCem is engaged in the research of the behaviour of its products with different types of aggregates. This is why research topics have been developed at the Mexican Transport Institute (IMT) since 2007; one of the most important aspects of research is the one being carried out at the Accelerated Pavement Test Laboratory of the IMT Infrastructure Division, which consists in the assessment of a test section (IMT Strip 1 – PowerCem) of RoadCem Synthetic Zeolite using the first Heavy Vehicle Simulator ("HVS").

Heavy Vehicle Simulator (HVS)

The HVS, Mark VI model, with a total length of 32 meter and a 48-ton mass, allows applying a pressure range from 1/2 up to 20 tons at different speeds. The simulator may apply up to 11 tons in half a dual axis and up to 20 tons in one aircraft wheel (Boeing 727). Furthermore, the Mark VI device can be operated in two versions, a short version with a 12-m central beam and a long version with up to 18 m in length. This would allow to increase the test section from 9 to 15 meters, as well as the speed, from a maximum of 12 km/h for the short version to up to 20 km/h in the long version.

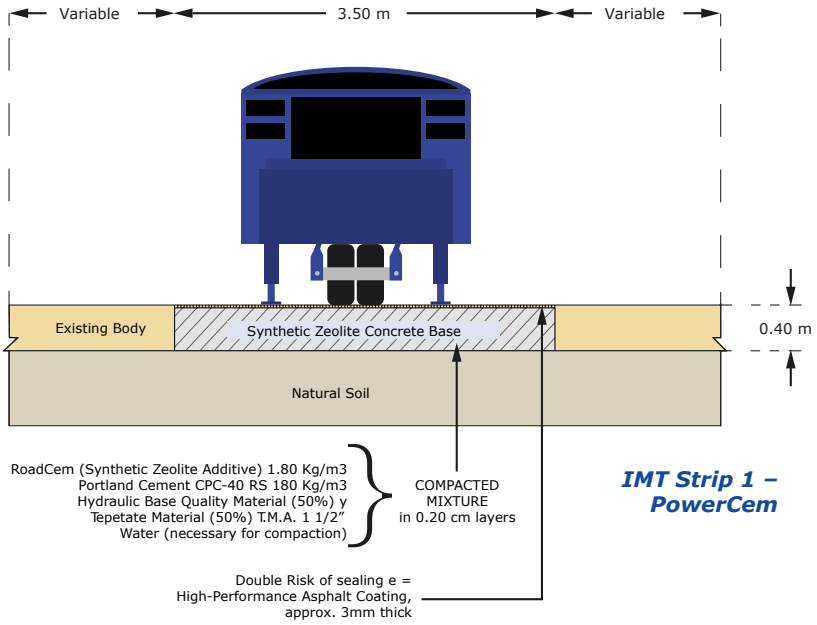
Middle Dual Axis

Aircraft Wheel

The Heavy Vehicle Simulator (HVS) has the purpose of quickly testing multi-layer pavement structures in roads and/or air strips on an actual scale so as to determine its response and behaviour under accelerated and controlled damaged in a short amount of time.

The figure displays the geometry and materials employed in the construction of the IMT Strip 1 – PowerCem

Stript 1 IMT – PowerCem was constructed in two 20cm layers each, and is equipped with a group of sensors and instruments used to measure pavement response on load application.



IMT Strip 1 – PowerCem

Nucleus extraction, which displays the fusion of two 20cm layers

The device also includes a comprehensive instrument system, including strain gauges, pressure cells, gasket deflection gauges, thermocouples, and technology also developed by the CSIR (Council of Scientific and Industrial Research) called MDD (Multi-Depth Deflectometer).

The following are some of the main devices employed in the IMT Strip 1 – PowerCem:

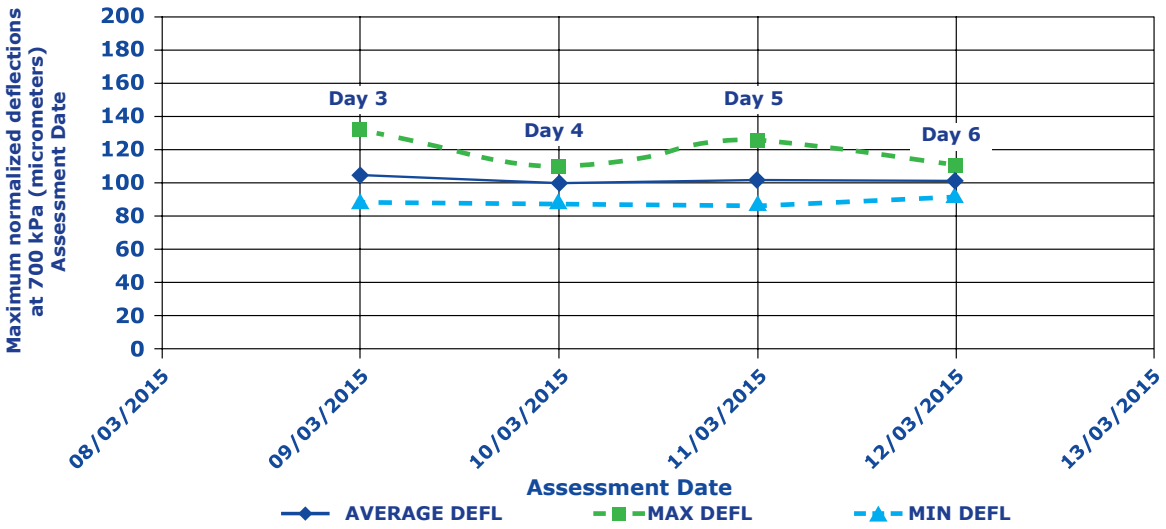
Deformation gauge: Measures horizontal stress and deformations in the pavement

Multiple-Depth Deflectometer: Measures deflections at different depths. of the pavement structure and complete deflection curves.

Thermocouples: Two cables of different materials joined at one end to measure temperatures.

The different instruments and sensors installed in the pavement allow to review the structural responses generated from the passing of pressure loads, as well as their evolution during pressure accumulation, which will allow the development of behavioral models for each instrumented layer, as well as the evolution of the properties of materials included.

Another test carried out in IMT Strip 1 – PowerCem is the measurement of deflections using the Heavy Weight Deflectometer. The figure below shows the evolution in rigidity of the RoadCem Synthetic Zeolite Concrete base (RSZCB) with regards to time, considering the first six curing days from the date of construction (Construction date: March 06, 2015).



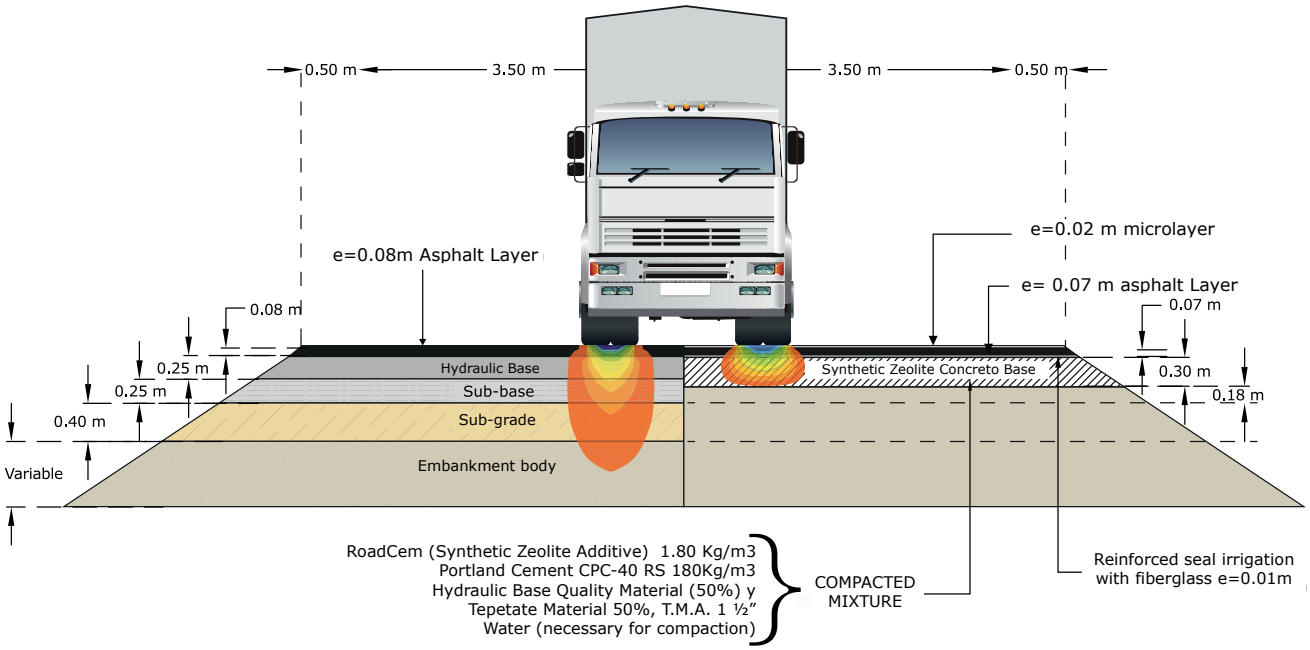
Evolution of rigidity with regards to time for the RSZCB

It is worth noting that PowerCem is a company committed to Research, Training, Innovation, and Continuous Improvement. Who have implemented a Program for constructing these new testing sections to continue investigating the behaviour of RoadCem Synthetic Zeolite Concrete (RSZC) with different types of aggregates, dosages, thicknesses, of layers, etc.

Areas assigned for the following test sections.

At the testing strip of the Vehicular Dynamics Laboratory of the Mexican Transport Institute (IMT), a test strip, 35 meters in length by 3.5 width and 0.30 thickness was created, named "IMT Strip 2 – PowerCem". The figure displays the geometry and materials employed in the construction of both the IMT Strip and the aforementioned section.

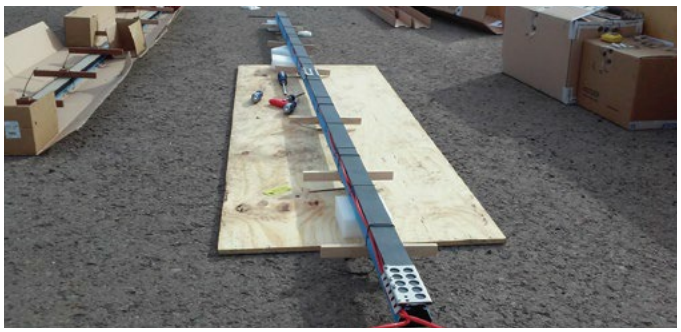
IMT Strip 2 – PowerCem



Transversal section of the structure at the Vehicular Dynamics Laboratory Testing Strip

The tasks carried out were aimed at adapting the structural conditions of the pavement for installing sensors of a dynamic weighing system. Such systems are used for the estimation of a vehicle mass from the measurement of the dynamic interaction pressures between the wheels and the pavement when a vehicle passes through the strip without stopping.

Sensors are embedded in the upper pavement layer, and thus a high rigidity of the system supporting layer and a proper surface uniformity must be guaranteed. This is why we chose to measure the evolution of deflections with regards to time using the Heavy Weight Deflectometer (HWD), and also measured the International Roughness Index (IRI).



(a)

a) Dynamic weighing sensor

(b)

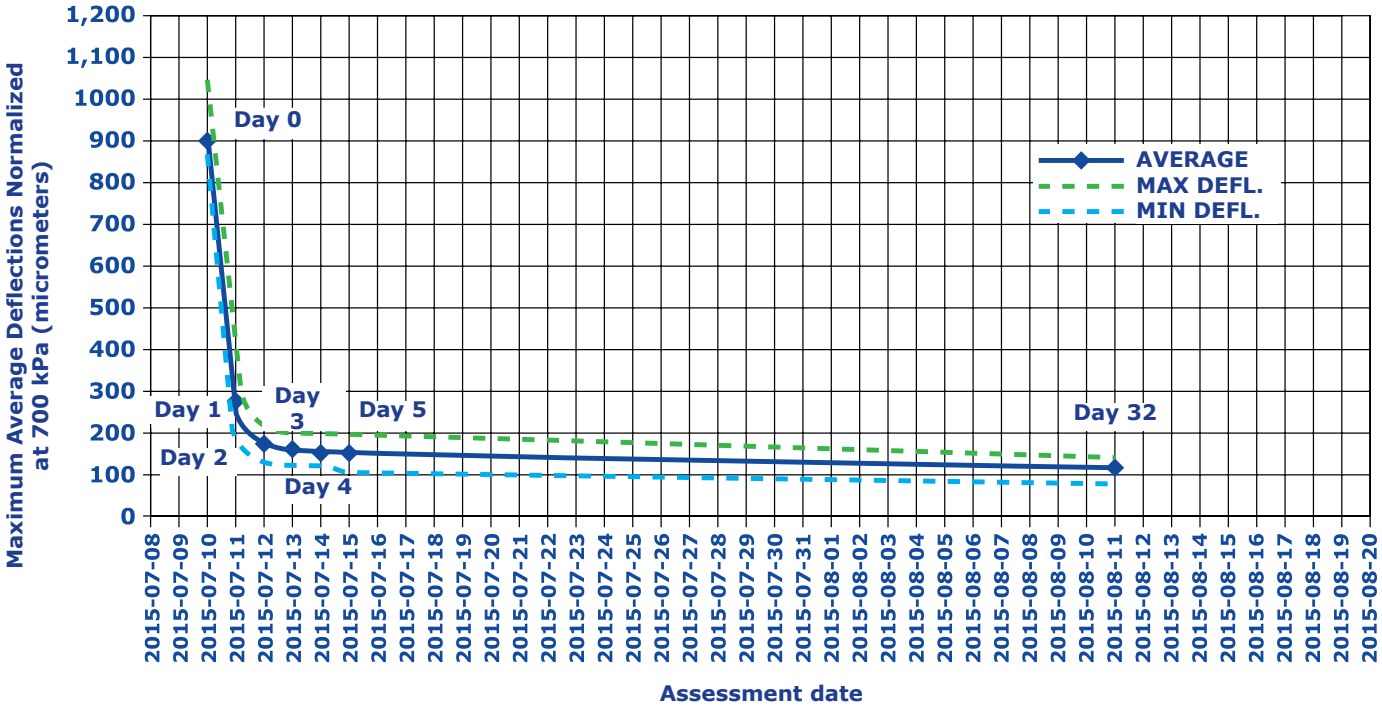
b) Embedded sensors in the asphalt layer of IMT Strip 2 – PowerCem

The table below displays the main requirements to be complied by pavement structures to guarantee that sensors of this kind work appropriately, according to the manufacturer's specifications

	Excellent	Good	Acceptable
Deflection (micrometers)	≤ 200	≤ 350	≤ 550
IRI	0 a 1.3	1.3 a 2.6	2.6 a 4

Main pavement structure requirements for an adequate performance of the dynamic weighing sensors.

The deflection values retrieved with the HWD test at the structure containing the RoadCem Synthetic Zeolite Concrete Base (RSZCB) are displayed below:



By reducing the deflections, it may be noticed that the rigidity of the RoadCem Synthetic Zeolite Concrete Base (RSZCB)
quickly increases in the first hours after being construction; while it is also noted that 3 days later values below 200 micrometers were already recorded, which indicates an "Excellent" rating.

Regarding the International Roughness Index (IRI), the section with the RoadCem Synthetic Zeolite Concrete Base (RSZCB) was recorded as 1.67 which, according to the parameters established in the above table, falls within the "Good" rating.

Wherefore it may be concluded that the structure is in good conditions for a proper functioning of the dynamic weighing sensors.