



# PARDAK<sup>®</sup>110

INNOVATION AND EXPERIENCE WITH  
FLEXIBLE ROOFTOP PARKING DECKS

 **ZOONTJENS**  
A CRH COMPANY



# ROOFTOP CAR PARKING FROM PLANNING

**The more traffic increases and the more space is occupied by buildings, the more attractive the option to park on the roofs of offices, shopping centres, car dealerships and public buildings in city centres becomes.**

As long ago as 1987, Zoontjens developed an innovative solution for rooftop parking using precast concrete slabs: the Pardak®90 system for intensive passenger car traffic. Over 1.5 million square metres of this system were sold in the UK, the Netherlands, Germany, France, Belgium, Luxembourg, Austria, Italy and Switzerland.

On the basis of this successful system, and our 30+ years experience, we have now developed the new, patented Pardak®110 system, designed for intensive passenger car traffic with a total weight of up to 35 kN.

The main changes are the considerably more effective tensioning elements and the plastic corners, enabling accurate slab height levelling. Furthermore, the slab sizes have been increased to a grid size of 110 cm x 110 cm x 9.6 cm.

## PARDAK®110 PAVING

The Pardak®110 paving system consists of the following components:

- Pardak®110 precast concrete slabs
- Pardak®110 tensioning elements
- Pardak®110 pressure distributors
- Pardak®110 corner piece

## PARDAK®110 PRECAST CONCRETE SLABS

The non-reinforced Pardak®110 slabs, with average dimensions of 109.6 cm x 109.6 cm x 9.3 cm, are manufactured under carefully controlled conditions in our factory. With a joint width of 3-5 mm this results in a modular grid size of 110 cm. The properties of the concrete slabs have been tested in accordance with DIN EN 1339 "Concrete paving flags" by the German Güteschutz NRW. The highest quality levels were reached on all requirements, such as dimensional stability, flexural strength, fracture load, resistance to abrasion and frost/road salt resistance (see data sheet). In addition, a special institution tested the skid resistance of the Pardak®110 slabs and gave it the highest possible value: R13.

The slab surface features drainage grooves in a diamond pattern. Apart from giving the surface its visual characteristics, these grooves drain the residual water towards the joins

## THE PARDAK®110 SYSTEM OFFERS THE FOLLOWING SIGNIFICANT ADVANTAGES:

- *The owner/developer gets a sustainable rooftop car park with a good price/performance ratio that takes very little time to install.*
- *The operator has relatively low maintenance costs thanks to the flexible slab system that can easily be opened and sealed again, if and when required.*
- *The car park customer can park on a safe and attractive rooftop car park, without puddles when it rains, as the water is rapidly drained through the joints between the slabs.*
- *The installer can be confident of consistently meeting construction programmes thanks to the virtually weather-independent construction, consisting of precast concrete slabs and loose XPS thermal insulation sheets.*



between the slabs from where it flows freely into the void for water drainage under the slabs and then into the roof outlets. And drainage slots in the sides of the slabs ensure even faster water drainage. As a result, after heavy rain, all water is quickly removed from the actual Pardak®110 surface and no puddles will form, not even if the slabs have been installed on a roof surface without fall. This provides for more comfort and safety for drivers and pedestrians. The Pardak®110 slabs, each weighing 270 kg, are laid using readily available, highly manoeuvrable installation machines with vacuum lifting technology.

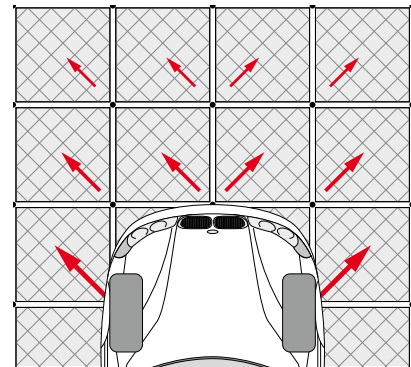
## PARDAK®110 TENSIONING ELEMENT

The main component of the Pardak®110 system is the patented tensioning element. These elements are installed and tensioned at all points where the corners of adjoining slabs come together and are then adjusted to the right tension. The function of the Pardak®110 tensioning elements is to close the individual Pardak®110 slabs up against one another to create a unified deck. This ensures that the deck accommodates any manufacturing and laying tolerances as well as thermal expansion and other movements in the building, while keeping the slab surface stable at all times.

The tensioning element initially serves as a buffer to absorb the considerable horizontal forces that mainly occur as vehicles brake, accelerate and turn. The tensioning elements distribute some of these forces among the adjoining Pardak®110 slabs. The relative vertical movements between two adjoining slabs which occur as a vehicle passes over the joints are also reduced. The tensioning elements of the Pardak®110 system thus ensure that the pavement is stable at all times.

## COMPONENTS OF THE TENSIONING ELEMENT

The tensioning elements are installed in a square opening at all points where joints cross, and directly over the centre of the pressure distributors. The opening results from the geometry of the slabs which have diagonal 3-cm long side faces on their corners.



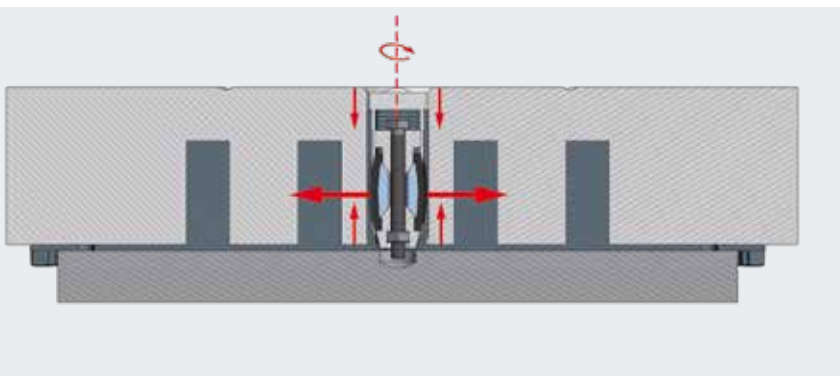
### TRANSMISSION OF HORIZONTAL FORCES

*Cross section of the Pardak®110 system with a tensioning element. The main function of the tensioning elements is to absorb and distribute horizontal forces.*



### PARDAK®110 PRESSURE DISTRIBUTOR

*The circular pressure distributors have a diameter of 400 mm and are on average 30 mm thick. They are placed under the corners of the Pardak®110 slabs. The function of the pressure distributors is to absorb and distribute the vertical forces that occur when cars pass over the parking surface. They also reduce the contact noise of the vehicle tyres and create a cavity under the slabs through which water can drain away. The Pardak®110 pressure distributor is the result of extensive and careful development. The pressure distributors are made of high-quality rubber granulate which is pressed into the desired shape.*



*Cross section of the Pardak®110 system with a tensioning element.*

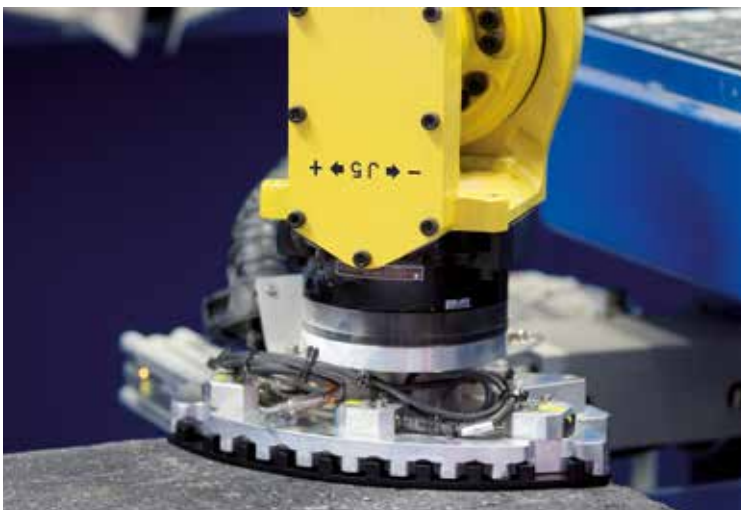
The tensioning element contains plastic parts, surrounded by 4-mm thick rubber sleeves. These plastic parts can be adjusted by tightening the interior set screw. This increases the diameter of the tensioning element, resulting in a tension being exerted on the raised elements of the corner piece (see page 5) which is immediately propagated onto the slabs.

## PARDAK®110 CORNER PIECE

The Pardak®110 corner pieces perform important tasks, particularly ensuring dimensional accuracy when tensioning the slabs, making them an important constituent of the patent for the Pardak®110 system. These plastic corners are applied directly to the corners of the Pardak®110 slabs in factory conditions. They are a quarter circle with sides of 20 cm. Both sides have two raised edges, 2 mm thick, that serve as lateral delimiters and as spacers in order for the slabs to be laid more accurately. A further raised plastic part, sized 2.5 x 7.5 cm, has been created on the corner of the plastic element. The tensioning element is tensioned against this part.

## THE FUNCTION OF THE CORNER PIECE

- Compensating for the unavoidable tolerances in slab thickness. The variations in thickness of the Pardak®110 slabs are measured first, using a laser levelling device.
- This height compensation is a precondition to enable the tensioning element to be tensioned horizontally and centrally between the slabs.
- The corners serve to accurately centre the pressure distributors by means of the locating lips on the underside.
- A groove has been integrated in the raised plastic strip, facing the concrete, at half the slab height. The tensioned element fits accurately into this hollow and is effectively pressed against the concrete. This reduces the vertical relative movements between two adjoining Pardak®110 slabs which occur as a vehicle passes over them.



## SOUND INSULATION MEASUREMENTS

*Peutz, the renowned Dutch sound insulation institute, performed sound level tests on the rooftop car park of the "The Wall" shopping centre on the A2 motorway near Utrecht in the Netherlands. This 34,000m<sup>2</sup> and 800 m long rooftop car park was produced by Zoontjens, using the Pardak®110 system, in 2008.*

*The Peutz test report confirmed that the dB values found there were considerably lower than those of the Pardak®90 system. This is due to the more intensive horizontal and vertical tensioning of the Pardak®110 slabs.*

*Robots in the factory are used to find the right corner piece and glue it to the underside of the Pardak®110 slab. This ensures that all concrete slabs are of the same thickness, with a ± 1-mm tolerance.*

## ROOF STRUCTURE

Pardak®110 is generally installed on insulated roofs. The inverted roof structure is specifically suitable for this, as long-term experience has shown.

The components of the rooftop car park pavement structure on an inverted roof are:

- Waterproofing layer
- Thermal insulation
- Pardak®110 slabs

This layered construction of the rooftop car park matches the structure of an approved inverted roof where the waterproofing layer is located below the thermal insulation layer. Around the edge of the rooftop parking system, the perimeter restraint must be able to withstand a horizontal force of 3.5kn/lnm.

## WATERPROOFING LAYER


To prevent underflow between the concrete deck and the waterproofing layer, bonded sealing in accordance with DIN 18195-5 is recommended. We are very satisfied with the use of liquid plastics at the edges of the deck and at other points where the waterproofing layer is connected to the building and to various structural elements.

## THERMAL INSULATION

Inverted roofs have proven their worth both in theory and in practice. Several studies have shown their service life to exceed 30 years. The advantage of an inverted roof is the excellent protection provided for the waterproofing system against thermal and mechanical loads. This prevents the risk of the waterproofing layer being damaged by direct contact with the deck which is being subjected to dynamic loads.

## REFURBISHMENT

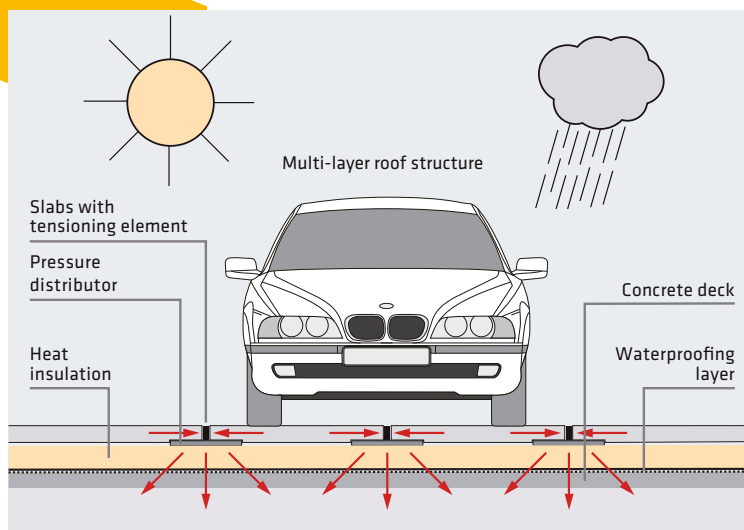
Old rooftop car parks that have sustained multiple damage often have to be refurbished. A first requirement for owners and operators is to know how the car park can be refurbished such that it can be put to optimum use again quickly, given the existing situation. The state of the existing building and the materials used then have to be assessed. Another question that often crops up concerns the available fall and any corresponding height problems at connections and in the surface. Zoontjens has many years experience in this field, so it pays to contact us with your questions.



*If customers so require, coloured Pardak®110 slabs or Pardak®110 slabs with a top coat made of granulate materials in different colours can be installed, e.g. to demarcate parking bays. Pedestrian areas can be clearly demarcated using precast kerbs.*

A thorough site survey, where the existing situation of the building is assessed (e.g. damage to the concrete deck due to road salt), and static testing often reveal that the Pardak®110 system of precast concrete slabs is the best solution. When refurbishing rooftop car parks with high traffic intensity, the Pardak®110 system offers operators the following significant economic advantages:

- › In general, the building time required to restore the driving surface is shortened considerably. This is due to the fact that the precast concrete slabs can be laid quickly and the work can continue in virtually all weather conditions, even in winter, and the effective and quick tensioning of the Pardak®110 slabs;
- › The flow of traffic can be restored quickly in critical areas, e.g. on and in front of the ramps between two storeys.



- › Independent movement of the Pardak®110 system relative to the building and the concrete deck
- › Weather-independent installation
- › No puddles
- › Easy removal and access to the thermal insulation and the waterproofing layer



### ADVANTAGES OF USING THE PARDAK®110 SYSTEM TO REFURBISH AN EXISTING ROOFTOP CAR PARK

- › Installing a fall on inverted roofs is usually not necessary and, from a technical and economic perspective, this is often the best solution and one which is also permitted under construction law.
- › The construction depth of a pavement of Pardak®110 slabs is only 126 mm.
- › Three phases of the refurbishment process can take place on the building site at the same time without any significant problems.

**Phase 1:** The section of the old, damaged pavement that has not been refurbished yet is still available to traffic. The materials used for refurbishing are temporarily stored on this section as well.

**Phase 2:** Intensive refurbishment work (dismantling the existing roof structure, installing a new waterproofing layer and thermal insulation, laying the Pardak®110 slabs).

**Phase 3:** Traffic is possible again on the part of the rooftop car park that has already been refurbished due to the major advantage that the Pardak®110 pavement can be driven on immediately after the Pardak® slabs have been tensioned – no curing is involved.

### TECHNICAL AND ECONOMIC ADVANTAGES

- › Proven roof structure of the inverted roof with Pardak®110 slabs
- › High-quality concrete – Pardak®110 slabs are industrially precast
- › Permanent stability of the car park pavement
- › No fall layer is required
- › Intelligent detailed solutions
- › Rapid laying of the Pardak®110 slabs and the XPS sheets
- › The advantage of a rooftop car park which is free from water
- › Traffic noise is reduced by the pressure distributors and the intensively tensioned Pardak®110 slabs.



*The specifications, construction, and details have been gathered in accordance with the latest technical regulations and with the greatest care. Zoontjens International B.V. does not accept any liability for any errors or any incompleteness nor for the consequences thereof. In the interest of innovations and improvements, we reserve the right to modify our products and systems.*

## WHAT IF THE WORLD WERE TWICE AS BIG

It can be, as far as we're concerned. Our world, twice as big. A world that we are helping to design and construct perfectly with our roof slab systems. Our many years of experience have made us the number one expert in rooftop paving. For sustainable roofs, livable roofs for socialising. We interact with architects and contractors every day. With roofers and project developers. Creators and constructors. We listen to them, work with them and advise them. That's why we're the number one party with the best rooftop vision. It's our higher ground.