






Number BAR 17-055/01/A Replaces: -	  <p style="text-align: center;">BDA Agrément® BAR 17-055/01/A</p>	Category Parking decks																							
Date 2017-10-16		Phase Assessment																							
Project number 15-B-0840 / 2069		Subject Parking deck systems for renovation and new roofs with a low to high traffic intensity																							
Validity www.kiwa.co.uk/bda																									
Systems Agrément holder Description Scope (use) Summary of Agrément Major points of assessment Statement	<p>Pardak® 80, Pardak® 110 and Pardak® XL Systems</p>  <p>Zoontjens Centaurusweg 19-25 P.O. Box 61 NL-5000 AB Tilburg T.: +31 (0)13-5379379, F.: +31 (0)13-4550527, E.: info@zoontjens.nl, I.: www.zoontjens.nl</p> <p>The Pardak® 80, Pardak® 110 and Pardak® XL Systems (hereafter “the Systems”) consist either of concrete slabs combined with moulded slab supports made of rubber granulate (Ø 400 mm, 30 mm thick), cross-pieces and tensioning elements (Pardak® 80 and Pardak® 110), or of reinforced concrete slabs on a bedding of natural stone granulate and a ventilating drainage layer (Pardak® XL). For Pardak® 80 and Pardak® 110 the entire slab surface is tensioned, constituting a stable unity. For Pardak® XL the stability is obtained through careful perimeter confinement.</p> <p>Concrete slab systems for insulated and non-insulated parking decks for renovation projects and new roofs with a bearing capacity as indicated in table 1, see also section 3.</p> <p>Table 1 - Overview of slab systems</p> <table border="1"> <thead> <tr> <th>Pardak® type</th> <th>Traffic intensity</th> <th>Load class³</th> <th>Max. overall weight of vehicle (kN)</th> <th>Max. axle pressure (kN)</th> <th>Max. jack load (kN)</th> </tr> </thead> <tbody> <tr> <td>Pardak® 80</td> <td>low</td> <td>2</td> <td>35</td> <td>10.5</td> <td>14</td> </tr> <tr> <td>Pardak® 110</td> <td>high</td> <td>2</td> <td>35</td> <td>10.5</td> <td>14</td> </tr> <tr> <td>Pardak® XL</td> <td>high</td> <td>3</td> <td>160</td> <td>135</td> <td></td> </tr> </tbody> </table> <p>This BDA Agrément® covers the following:</p> <ul style="list-style-type: none"> • Conditions of use; • Sources, including relevant codes of practice and test reports; • Independently verified product characteristics; • Quality control and annual verification; • Points of attention for the specifier and examples of details; • Installation procedure; • Compliance with Building Regulations; • Compliance with non-Regulatory Standards. <p>Structural aspects (section 3) The structural bearing capacity and stability of the Systems have been assessed. The Systems will resist the static and dynamic loadings as indicated in table 1.</p> <p>Thermal performance aspects (sections 6, 7 & 8) The thermal performance of an insulated flat roof construction using one of the Systems have been assessed according to BS EN ISO 6946 and BR443. The Systems can contribute in meeting the U-value requirement for a flat roof.</p> <p>Condensation and water penetration risk (section 6, 7 & 8) The performance of an insulated flat roof construction using one of the Systems with regard to interstitial condensation, surface condensation and water penetration has been considered.</p> <p>Behaviour in relation to fire (section 6.2.01) An insulated flat roof construction using one of the Systems will meet the UK requirements.</p> <p>Durability (section 6.2.02) The Systems are stable, rot-proof and durable and will remain effective for the life of the roofing on which it is installed provided they are specified, installed and maintained in accordance with this BDA Agrément®.</p> <p>It is the opinion of the Kiwa BDA Expert Centre Building Envelope (ECBE) that the Systems are fit for their intended use, provided they are specified, installed and maintained in accordance with this BDA Agrément®.</p> <p>Professor Nico Hendriks, MSc  ECBE Chairman</p> <p>Chris van der Meijden, MSc  Kiwa BDA Technical Director</p>	Pardak® type	Traffic intensity	Load class ³	Max. overall weight of vehicle (kN)	Max. axle pressure (kN)	Max. jack load (kN)	Pardak® 80	low	2	35	10.5	14	Pardak® 110	high	2	35	10.5	14	Pardak® XL	high	3	160	135	
Pardak® type	Traffic intensity	Load class ³	Max. overall weight of vehicle (kN)	Max. axle pressure (kN)	Max. jack load (kN)																				
Pardak® 80	low	2	35	10.5	14																				
Pardak® 110	high	2	35	10.5	14																				
Pardak® XL	high	3	160	135																					
Version 01	<p style="text-align: center;">Kiwa BDA Expert Centre Building Envelope (ECBE)</p> <p>Kiwa BDA Avelingen West 33 P.O. Box 389 4200 AJ Gorinchem, The Netherlands +31 (0)183 66 96 90</p> <p>Kiwa Ltd. Unit 5 Prime Park Way Prime Enterprise Park Derby, DE1 3QB, United Kingdom +44 (0)7718 57 05 64</p> <p style="text-align: center;">Copyright© 2017 Kiwa BDA www.kiwa.co.uk/bda</p>	Page 1 of 12 pages																							

<p>1 Application conditions</p>	<p>1 Application The assessment of the Systems from Zoontjens involves their application on correctly detailed flat roofs, and constructions in accordance with the installation guidelines of the Agrément holder and the instructions in this BDA Agrément[®] with special attention to:</p> <ul style="list-style-type: none"> - the loading capacity of the slab system, as indicated in table 1; - the stability of the slab surface; - the connection between the slab surface and the surrounding upstands and other connections. <p>2 Assessment (see also section 2 for the sources) Kiwa BDA Expert Centre Building Envelope (ECBE) has checked the installation guidelines based on the current Codes of practice^{4,5,6} and has assessed the independent quality documents from the Agrément holder^{9,10}; the performance in actual practice has been assessed by project visits¹¹.</p> <p>3 Installation It is recommended that the quality of installation and workmanship is controlled by an independent competent inspector. This inspector can be either a qualified employee of the specifier or a qualified employee of a consulting engineer. The product shall be installed strictly in accordance with the instructions of the Agrément holder and the requirements of this Agrément.</p> <p>4 Geographical scope The validity of this document is limited to England, Wales, Scotland and Northern Ireland, with due regard to section 11 Building Regulations.</p> <p>5 Validity The purpose of this BDA Agrément[®] is to provide for well-founded confidence to apply the Systems in the described applications and according to approved specifications (see also section 7). According to the BDA Guideline - BDA Agrément^{®1} the validity of this BDA Agrément[®] is three years after the issue date, after which the validity period can be extended every three years after positive review. The validity will lapse if ECBE establishes that the clause in section 6.1 of this document is not met or in case that any non-conformity, found at the annual verification visit (see section 5) has not been corrected within the required time.</p>	
<p>2 Sources</p>	<ol style="list-style-type: none"> 1 BDA Guideline - BDA Agrément[®], 2015-06-30 2 NHBC Standards 2017 Chapter 2.1, The Standards and Technical Requirements and Chapter 7.1 Flat Roofs and Balconies 3 BDA Agrément[®] BAR 15-051/01/A Pardak[®]80, Pardak[®]110 en Pardak[®]XL Systemen, 2015-10-30 (in Dutch) 4 BS 5250:2011 Code of practice for control of condensation in buildings 5 BS 6229:2003 Flat roofs with continuously supported coverings - Code of practice 6 BS 8217:2005 Reinforced bitumen membranes for roofing - Code of practice 7 BS EN ISO 6946: 2007 Building components and building elements -Thermal resistance and thermal transmittance - Calculation method 8 BR443: Conventions for U-value calculations, 2006 edition, BRE Scotland 9 KOMO[®] Quality Assessment Certificate K 2063/06 dated 2015-01-01 : Concrete slabs, Zoontjens Beton B.V. 10 KOMO[®] Quality Assessment Certificate K 2064/08 dated 2015-01-01 : Concrete roof slabs, Zoontjens Beton B.V. 11 BDA Inspection Report 15-B-0840 Parking decks in Bradford, Newcastle and Whitley Bay, 2016-05-10 12 DIN 51091:1992 Prüfung von Bodenbelägen. Bestimmung der rutschhemmenden Eigenschaft. Naßbelastete Barfußbereiche. Begehungsverfahren. Schiefe Ebene. Berlin, Beuth Verlag 13 BS-EN 1339:2010 Concrete slabs - Requirements and test methods 14 Prüfbericht Nr. 15/0413-1/G über die Prüfung von 4 Parkdeckplatten "PD 110", Güteschutz Beton NRW e.V., 2015-06-22 15 Allgemeine bauaufsichtliche Zulassung Z-23.4-224 Wärmedämmsystem Umkehrdach unter Verwendung von extrudergeschäumten Polystyrol-Hartschaumplatten "ROOFMATE SL A", "ROOFMATE SL-A-P", "FLOORMATE 500-A", "FLOORMATE 500-A-P", "FLOORMATE 700-A" und "FLOORMATE 700-A-P", 2015-06-02 16 Method Statement Pardak 110 and 80, Zoontjens Beton B.V., 2016-10-27 17 BS 476-3:2004 Fire tests on building materials and structures. Classification and method of test for external fire exposure to roofs 18 ETAG 005:2004, parts 1, 2 and 7 Guideline for European Technical Approval of Liquid Applied Roof Waterproofing Kits <p>Remark: in the text of this document reference is made to some of these sources by adding the relevant source number in superscript.</p>	
<p>Version 01</p>	<p style="text-align: center;">Expert Centre Building Envelope Copyright[®] 2017 Kiwa BDA</p>	<p>Page 2 of 12 pages</p>

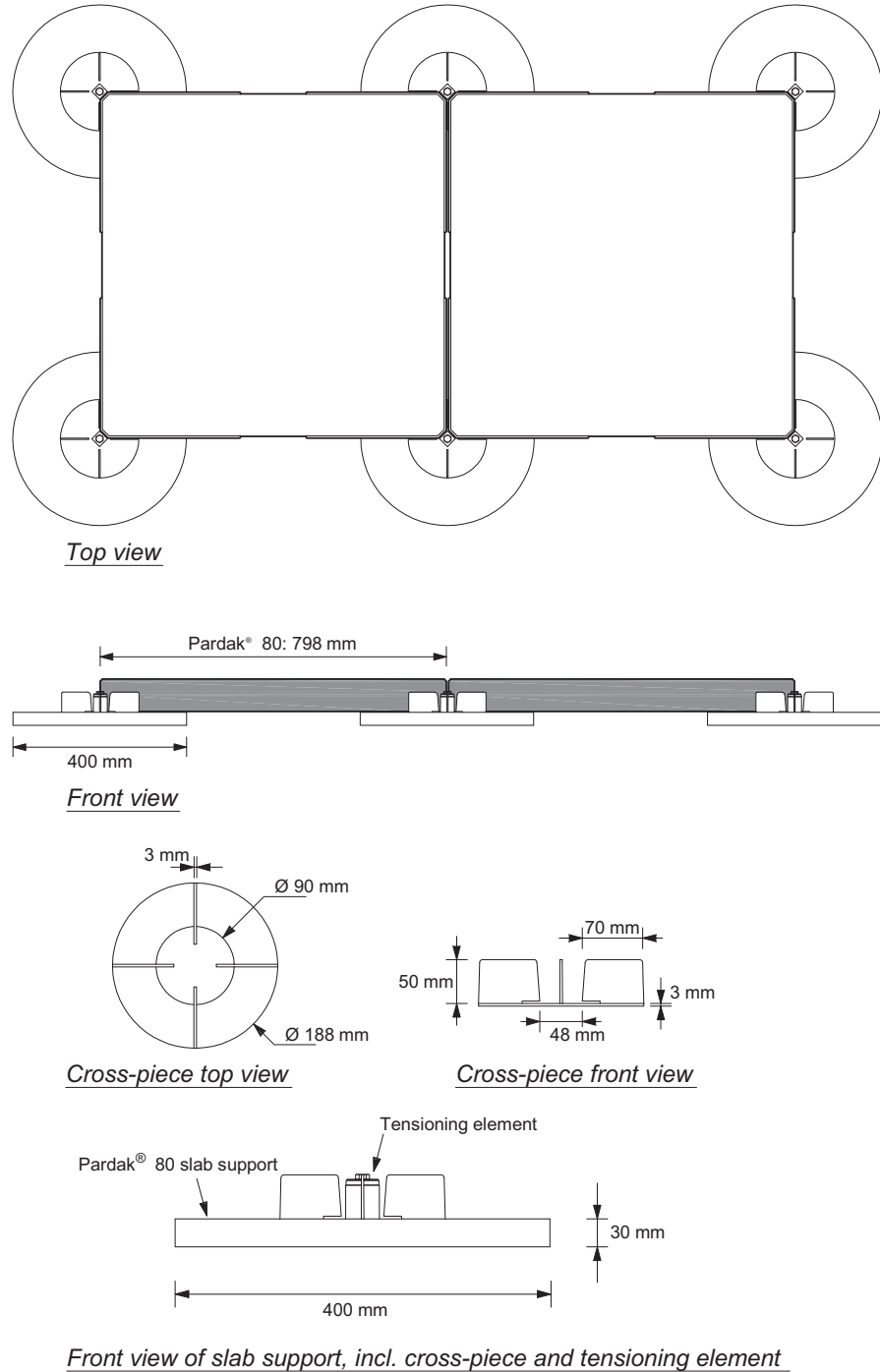
3 Independently verified system characteristics of components used for critical functions*)

Components of the Pardak® 80 and Pardak® 110 Systems (figures 1A and 1B)³

*) The critical functions which apply to this section and section 4 are structure, fire resistance, weatherproofing, durability and thermal insulation, as mentioned in Chapter 2.1, Technical Requirement R3 (Materials requirement) of the NHBC Standards²

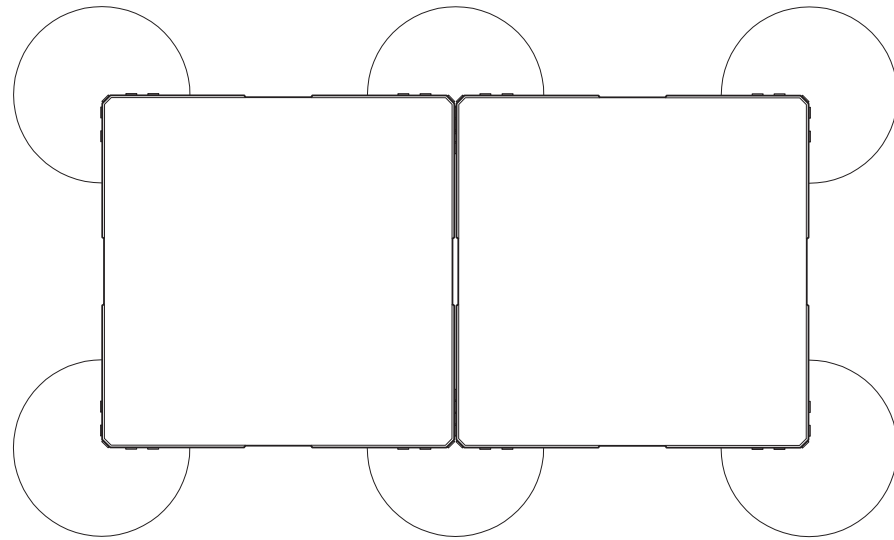
- Pardak® 80 and Pardak® 110 concrete slabs : see figures 1A and 1B
- Pardak® 80/110 extended concrete slab : see figures 1A and 1B
- Pardak® 80/110 slab supports (bonded rubber granulate) thicknesses : 30 (standard) and 12-40 mm
- Pardak® 80 cross-pieces : integrated in slab support
- Pardak® 80/110 tensioning elements : integrated in slab support
- Bitumen support discs : 1/1, 1/2 and 1/4 part of slab support
- Accessories : filling material for overlapping of roofing material

Figure 1A - Top views and cross-sections of Pardak® 80

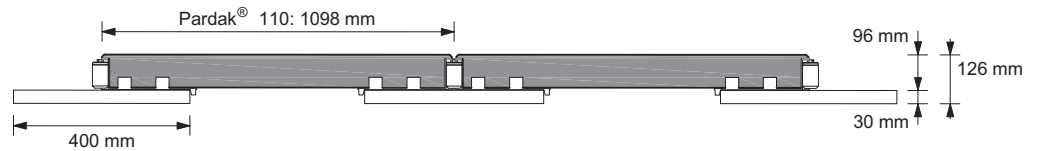


3 Independently verified system characteristics of components used for critical functions*)
(continued)

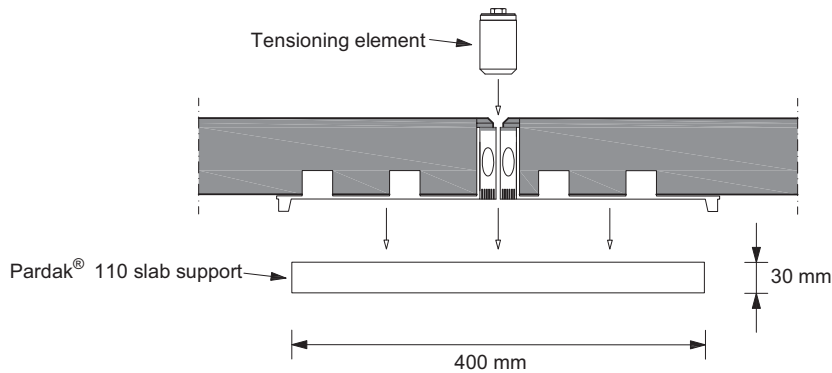
Figure 1B - Top views and cross-sections of Pardak® 110



Top view



Front view



General data of Pardak® 80 and Pardak® 110³

See table 2.

Table 2 - General data of Pardak® 80 and Pardak® 110

	Pardak® 80	Pardak® 110
Dimensions (mm)		
- standard	798 x 798 x 80	1096 x 1096 x 96
- extended concrete slab	1600 x 800 x 80	2200/1650 x 1096 x 96
Chamfered edge, horizontal	5	5
vertical	3	3
Installation height, average	110	126
Weight		
- per slab (kg)	117	270
- installed system (kg·m ⁻²)	182	230
Concrete strength class	C 55/67	C 55/67
Joint width (mm)	3 - 5	3 - 5
Colour(s)	Grey, other colours upon request	Grey, other colours upon request
Surface structure	Diagonal diamond pattern	Diagonal diamond pattern
Surface quality		
- anti-skid class (DIN 51091 ¹²)	R13 (highest class)	R13 (highest class)
Slab support quality (rubber granulate)	1050 kg·m ⁻³	1050 kg·m ⁻³
Load class ³	2 (vehicles up to 35 kN)	2 (vehicles up to 35 kN)

<p>3 Independently verified system characteristics of components used for critical functions*) (continued)</p>	<p>Permissible load¹⁴ Vehicle weights up to 35 kN, a static wheel load of up to 10.5 kN or a jack load of up to 14 kN (at any random location); condition: age of slabs at least 28 days and wheel print at least 100 mm x 150 mm.</p> <p>General details of Pardak® XL</p> <ul style="list-style-type: none"> • Nominal dimensions (see section 5, figures 3, 4 and 5) : 1996 mm x 1996 mm x 120/140 mm • Chamfered edges : 5 mm x 5 mm • Installation height, average : 190 - 210 mm • Weight <ul style="list-style-type: none"> - per slab : 1140/1330 kg - installed system : 295/340 kg • m² • Concrete strength class : C 40/50 (higher class upon request) • Joint width : see figures 3, 4 and 5 • Colour(s) : grey, other colours upon request • Surface structure : smooth • Surface quality, anti-skid class in acc. with DIN 51091¹² : R13 (highest class) • Load class³ : 3 (vehicles up to 160 kN, axle pressure 135 kN maximum) 	
<p>4 Quality control</p>	<p>The components of the Systems are produced under a Quality Management System, which enables the Agrément holder to demonstrate that the components fulfil the requirements of this Agrément. This means that the following aspects shall be covered:</p> <ul style="list-style-type: none"> • the quality objectives, quality planning, quality manual and control of documents must fully take on-board the objective of delivering system components that conform to the specifications in this Agrément; • the Agrément holder shall identify and document the essential requirements that are relevant for the components and the harmonised standards to be used or other technical solutions that will ensure fulfilment of the specifications in this Agrément; • the identified standards or other technical solutions shall be used as design input, and as verification that design output, as given in a continuous technical consulting service, ensures that the specifications in this Agrément will be met; • the measures taken by the Agrément holder to control production must ensure that the components conform to the identified safety requirements; • the Agrément holder in its measurement and control of the production process and finished components shall identify and use methods which are identified in standards or other appropriate methods to ensure that the specifications in this Agrément are met; and quality records, such as inspection reports and test data, calibration data, qualification reports of the personnel concerned, shall be suitable to ensure the fulfilment of the applicable specifications in this Agrément; • Kiwa Nederland B.V., Technical Assessment Body, has issued the KOMO® Quality Assessment Certificates K 2063/06 Concrete slabs⁹ and K 2064/08 Concrete roof slabs¹⁰ to Zontjens B.V., the holder of this Agrément. 	
<p>5 Annual verification procedure</p>	<p>In order to demonstrate that the specification and installation are in conformity with the requirements of the technical specification and installation procedures as described in this Agrément, visits to completed site works and/or ongoing site installations in the UK will be undertaken annually; the results of these visits are reported to the Agrément holder; non-conformities will have to be corrected within 3 months after the date of the report; remarks will be taken into account for the renewal of this Agrément after three years.</p>	
<p>6 Points of attention for the specifier</p>	<p>1 Permitted constructions - only constructions designed according to the specifications as given in this Agrément and as shown in section 9 or similar are allowed under this Agrément; in each case the specifier will have to cooperate closely with the Agrément holder.</p> <p>2 General</p> <p>01 Behaviour in relation to fire The use of the Systems will not affect the fire rating obtained by flat roofs with continuously supported coverings when evaluated by assessment or test to BS 476-3:2004¹⁷.</p> <p>02 Durability The Systems are stable, rot-proof and durable and will remain effective for the life of the roofing on which it is installed provided they are specified, installed and maintained in accordance with this BDA Agrément®.</p> <p>03 Maintenance Specifically with respect to the durability of the Systems it is essential that the Pardak® Systems roofs are annually inspected and maintained according to the guidelines of the Agrément holder¹⁶.</p>	
<p>Version 01</p>	<p style="text-align: center;">Expert Centre Building Envelope Copyright© 2017 Kiwa BDA</p>	<p>Page 5 of 12 pages</p>

<p>6 Points of attention for the specifier (continued)</p>	<p>3 Pardak® 80 and Pardak® 110</p> <p>01 Structural deck For the proper functioning of the parking deck system, it is highly important that the flatness of the structural deck on which the system is installed shall meet certain requirements (see section 7) and the top layer of the roofing material shall have the flattest possible structure; the best results are obtained by finishing the structural deck by power trowelling and post-treating it with a curing compound or plastic film; no upstands for expansion joints, light masts, etc. may be present in the concrete deck.</p> <p>02 Roof build-up Both the warm roof principle with CG insulation (Foamglas S3 or F) and the principle of an inverted roof with XPS 500 insulation (quality to be assessed by the Agrément holder) can be used for the roofing system; the inverted roof system is preferred here, as the waterproof layer is protected even more in that case. Note 1: Due to the required U-value for new developments (no greater than $0.18 \text{ W} \cdot \text{m}^2 \text{K}^{-1}$) and the relatively high thermal conductivity of Foamglas S3 and F, the application of a Foamglas insulation is only theoretically possible for new developments (required thickness 270 mm and 300 mm respectively), so it no longer is a logical choice. Note 2: For the inverted roof structure, two layers of XPS shall be applied to achieve the required U-value for new developments (no greater than $0.18 \text{ W} \cdot \text{m}^2 \text{K}^{-1}$). For a correct structure in terms of building physics, the first layer shall be at least 120 mm thick and the second layer at least 100 mm¹⁵. The separation layer on the whole package shall meet the requirements of the manufacturer of the XPS insulation.</p> <p>03 Slope The slope shall be at least 2%³ and be applied in two opposite directions, i.e. not on all sides.</p> <p>04 Roofing material</p> <ul style="list-style-type: none"> - in case of an inverted roof or an non-insulated parking deck, the first layer of the roofing material shall be fully bonded with bitumen 110/30 on a primed structural deck; - immediately after installing the roofing system, the XPS insulation and/or the slab system shall be installed to prevent damage; - in case of a warm roof with Foamglas® insulation boards, all work on the underlying surface shall be fully completed before installing the Foamglas® insulation boards; a compact Foamglas® roof is finished once the fully bitumen-filled joints are finished, the insulation boards are fully bonded to the structural deck and the first layer of the roofing system is fully bonded with bitumen. <p>05 Connections</p> <ul style="list-style-type: none"> - it is highly important that the slab system connects tightly to all upstands, ramps, etc. using pressure distribution strips of polyurethane-bonded rubber granulate (Granufix) on a backer rod of round PE foam \varnothing 40 mm; see also section 9 Examples of details; - design all roof details with square corner connections; - recessed design for rainwater drains; - at the entrance ramp only whole slabs should be used, otherwise use extended slabs (1.6 m for Pardak® 80 and 1.65 m or 2.20 m for Pardak® 110) and cut them to size if required. <p>06 Traffic signs</p> <ul style="list-style-type: none"> - the recommended maximum speed is 10 mph; - at the entrance to the parking deck, install a height restrictor at a height of 2.10 m and a sign indicating a weight restriction up to 35 kN (3.5 tonnes) for vehicles; - it is recommended to close the parking deck outside office hours and/or shop opening hours. <p>4 Pardak® XL</p> <p>01 Structural deck and slope</p> <ul style="list-style-type: none"> - during the installation phase, large parking decks are usually a key part of the building site; the concrete structural deck is well trafficable; especially if other building elements are being constructed on or next to the parking deck, careful coordination is required to ensure that the work of all the building partners runs smoothly with a minimum amount of damage; - a properly installed or poured concrete structural deck with the right slope makes it possible to fully bond the first layer of the roofing system to this underlying surface; the structural deck shall not change in height at the joints; hollow-core slabs and double T-beams shall be finished with a reinforced screed. <p>02 Roof build-up Both the warm roof principle with CG insulation (Foamglas® S3 or F) and the principle of an inverted roof with XPS insulation (Roofmate for Pardak® system or equivalent, to be assessed by the Agrément holder) can be used for the roofing system; the inverted roof system is preferred here, as the waterproof layer is protected even more in that case; see also the comment regarding Foamglas® in section 6.3.02.</p> <p>03 Roofing material See section 6.3.04.</p>	
<p>Version 01</p>	<p>Expert Centre Building Envelope Copyright© 2017 Kiwa BDA</p>	<p>Page 6 of 12 pages</p>

<p>7 Technical specification (Pardak® 80 and Pardak® 110) (continued)</p>	<p>07 Install the top layer of the roofing system in accordance with BS 8217⁶.</p> <p>08 Install the Systems to this surface using tensioning elements (in accordance with this BDA Agrément®); filling pieces at entrance and exit ramps shall be avoided; apply extended slabs in these locations and cut them to size if required; outside the traffic zones, e.g. on the external wall side or near rising surfaces on the railing side, smaller filling pieces may be used, as long as a proper connection is guaranteed.</p> <p>3 Non-insulated parking deck</p> <p>01 The flatness of the structural deck shall be determined using a steel straightedge; the height difference between the straightedge and the structural deck shall not exceed 3 mm in a grid of 600 mm or 4 mm in a grid of 1000 mm, any deviations are to be assessed by the Agrément holder.</p> <p>02 The structural deck shall have a design slope in the direction of the rainwater drains of at least 2% in no more than two opposite directions; in the 'gutter zones' created by this, design overflow drains in consultation with a structural engineer.</p> <p>03 Apply a fully covering bitumen primer coat to the concrete structural deck, which shall be dry and clean.</p> <p>04 Apply a fully bonded roofing system in accordance with BS 8217⁶.</p> <p>05 Install the roofing membranes in such a way that no draining obstructions are created towards the drains; apply the first layer fully bonded with bitumen 110/30 and level the bitumen flowing out around the overlaps using a filling knife; always cut off a corner at the overlaps of the underlying roofing membrane; if the top layer is not installed immediately after the first layer, e.g. because the first layer acts as an emergency layer, a thin finish coating of bitumen 110/30 shall be applied to the first layer.</p> <p>06 Install the top layer of the roofing system in accordance with BS 8217⁶.</p> <p>07 Install the Systems to this surface using tensioning elements (in accordance with this BDA Agrément®); filling pieces at entrance and exit ramps shall be avoided; apply extended slabs in these locations and cut them to size if required; outside the traffic zones, e.g. on the external wall side or near rising surfaces on the railing side, smaller filling pieces may be used, as long as a proper connection is guaranteed.</p>	
<p>8 Technical specification (Pardak® XL)</p>	<p>1 Inverted roof (figure 3)</p> <p>01 The flatness of the structural deck shall be determined using a steel straightedge; the height difference between the straightedge and the structural deck shall not exceed 3 mm in a grid of 600 mm or 4 mm in a grid of 1000 mm, any deviations are to be assessed by the Agrément holder.</p> <p>02 The structural deck shall have a design slope in the direction of the rainwater drains of at least 2% in no more than two opposite directions; in the 'gutter zones' created by this, design overflow drains in consultation with a structural engineer.</p> <p>03 Apply a fully covering bitumen primer coat to the concrete structural deck, which shall be dry and clean.</p> <p>04 Apply a fully bonded roofing system in accordance with BS 8217⁶.</p> <p>05 Install the roofing membranes in such a way that no draining obstructions are created towards the drains; apply the first layer fully bonded with bitumen 110/30 and level the bitumen flowing out around the overlaps using a filling knife; always cut off a corner at the overlaps of the underlying roofing membrane; if the top layer is not installed immediately after the first layer, e.g. because the first layer acts as an emergency layer, a thin finish coating of bitumen 110/30 shall be applied to the first layer'.</p> <p>06 Install the top layer of the roofing system in accordance with BS 8217⁶.</p> <p>07 Apply an insulation layer to the roofing system consisting of XPS 700 insulation (quality to be assessed by the Agrément holder), in a stretching bond, using the right thickness(es) to ensure that the required thermal resistance of the construction is met; tightly join up the boards individually and against upstands, etc., without seams.</p> <p>08 Install a studded drainage mat with a filter fleece to this surface (Parkdrain XL 600 hdsv).</p> <p>09 Install a bedding of natural stone granulate 4/8 or 2/7 with an average thickness of 50 mm; level this layer and mechanically compact it.</p> <p>10 - install the Pardak® XL concrete slabs in accordance with the laying plan using a vacuum laying machine in a tight English bond with joints of no more than 5 mm at the bottom, creating joints of no more than 25 mm wide on the chamfered edge due to the tapered shape of the slab edges; use of filling pieces at entrance and exit ramps shall be prevented; - fill the joints with natural stone granulate 4/8 mm by brushing in step by step.</p> <p>2 Warm roof (figure 4)</p> <p>01 The flatness of the structural deck shall be determined using a steel straightedge; the height difference between the straightedge and the structural deck shall not exceed 3 mm in a grid of 600 mm or 4 mm in a grid of 1000 mm, any deviations are to be assessed by the Agrément holder.</p> <p>02 The structural deck shall have a design slope in the direction of the rainwater drains of at least 2% in no more than two opposite directions; in the 'gutter zones' created by this, design overflow drains in consultation with a structural engineer.</p> <p>03 Apply a fully covering bitumen primer coat to the concrete structural deck, which shall be dry and clean.</p> <p>04 Apply an insulation layer of cellular glass (Foamglas® S/F) to the pretreated concrete structural deck using the right thickness to ensure that the required thermal resistance is achieved*; fully bond the insulation boards in a stretched bond with bitumen 110/30, in such a way that all board joints are also filled with bitumen; firmly connect the boards individually and against upstands, etc.; after installation, apply a full finish coating of bitumen 110/30 to the insulation boards to prevent moisture ingress due to rainwater and/or dew (minimum use 1.5 kg•m⁻²).</p> <p>*See also the comment regarding Foamglas® in section 6.3.02</p>	
<p>Version 01</p>	<p>Expert Centre Building Envelope Copyright© 2017 Kiwa BDA</p>	<p>Page 8 of 12 pages</p>

8 Technical specification (Pardak® XL)
(continued)

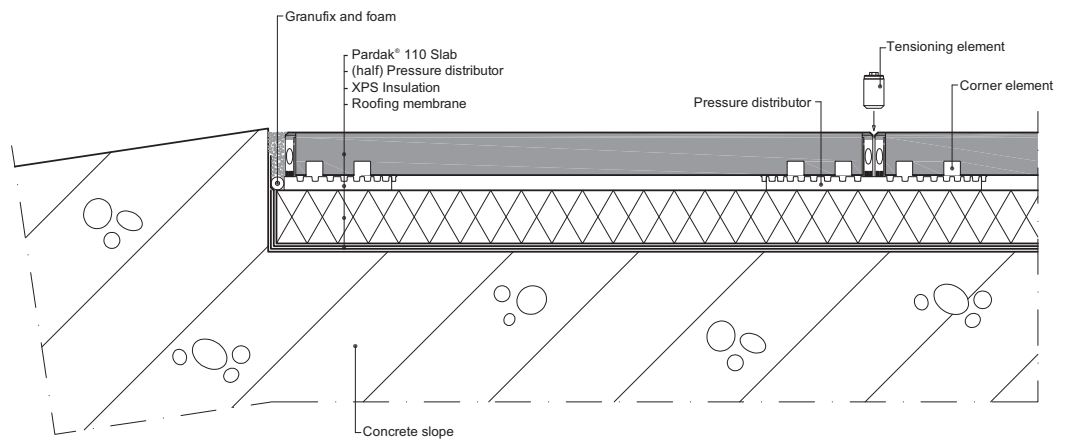
- 05 Apply a fully bonded roofing system in accordance with BS 8217⁶.
- 06 Install the roofing membranes in such a way that no draining obstructions are created towards the drains; apply the first layer fully bonded with bitumen 110/30 and level the bitumen flowing out around the overlaps using a filling knife; always cut off a corner at the overlaps of the underlying roofing membrane; if the top layer is not installed immediately after the first layer, e.g. because the first layer acts as an emergency layer, a thin finish coating of bitumen 110/30 shall be applied to the first layer.
- 07 Install the top layer of the roofing system in accordance with BS 8217⁶.
- 08 Install a studded drainage mat with a filter fleece to this surface (Parkdrain XL 600 hdsv).
- 09 Install a bedding of natural stone granulate 4/8 or 2/7 with an average thickness of 50 mm; level this layer and mechanically compact it.
- 10 - install the Pardak® XL concrete slabs in accordance with the laying plan using a vacuum laying machine in a tight English bond with joints of no more than 5 mm at the bottom, creating joints of no more than 25 mm wide on the chamfered edge due to the tapered shape of the slab edges; use of filling pieces at entrance and exit ramps shall be prevented;
 - fill the joints with natural stone granulate 4/8 mm by brushing in step by step.

3 Non-insulated parking deck (figure 5)

- 01 The flatness of the structural deck shall be determined using a steel straightedge; the height difference between the straightedge and the structural deck shall not exceed 3 mm in a grid of 600 mm or 4 mm in a grid of 1000 mm, any deviations are to be assessed by the Agrément holder.
- 02 The structural deck shall have a design slope in the direction of the rainwater drains of at least 2% in no more than two opposite directions; in the 'gutter zones' created by this, design overflow drains in consultation with a structural engineer.
- 03 Apply a fully covering bitumen primer coat to the concrete structural deck, which shall be dry and clean.
- 04 Apply a fully bonded roofing system in accordance with BS 8217⁶.
- 05 Install the roofing membranes in such a way that no draining obstructions are created towards the drains; apply the first layer fully bonded with bitumen 110/30 and level the bitumen flowing out around the overlaps using a filling knife; always cut off a corner at the overlaps of the underlying roofing membrane; if the top layer is not installed immediately after the first layer, e.g. because the first layer acts as an emergency layer, a thin finish coating of bitumen 110/30 shall be applied to the first layer'.
- 06 Install the top layer of the roofing system in accordance with BS 8217⁶.
- 07 Install a studded drainage mat with a filter fleece to this surface (Parkdrain XL 600 hdsv).
- 08 Install a bedding of natural stone granulate 4/8 or 2/7 with an average thickness of 50 mm; level this layer and mechanically compact it.
- 09 - install the Pardak® XL concrete slabs in accordance with the laying plan using a vacuum laying machine in a tight English bond with joints of no more than 5 mm at the bottom, creating joints of no more than 25 mm wide on the chamfered edge due to the tapered shape of the slab edges; use of filling pieces at entrance and exit ramps shall be prevented;
 - fill the joints with natural stone granulate 4/8 mm by brushing in step by step.

9 Examples of details

Figure 2 – Connection in perimeter zone



9 Examples of details
(continued)

Figure 3 - Insulated roof (inverted roof) Pardak® XL

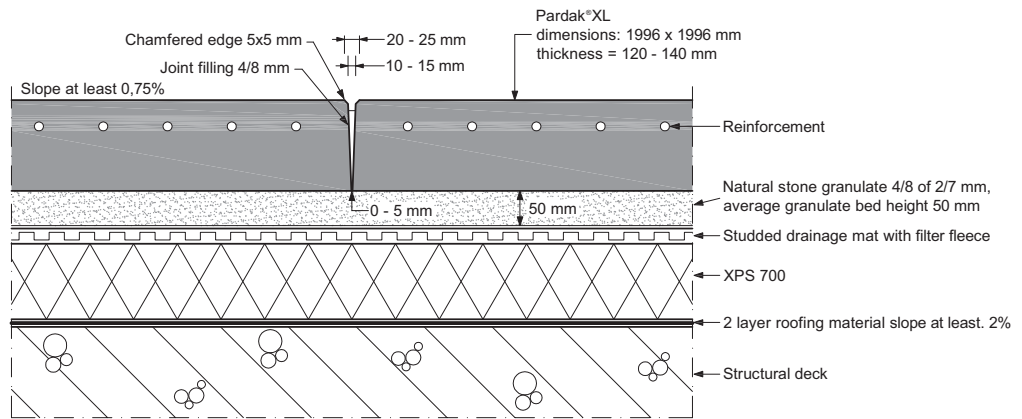


Figure 4 - Insulated roof (warm roof) Pardak® XL

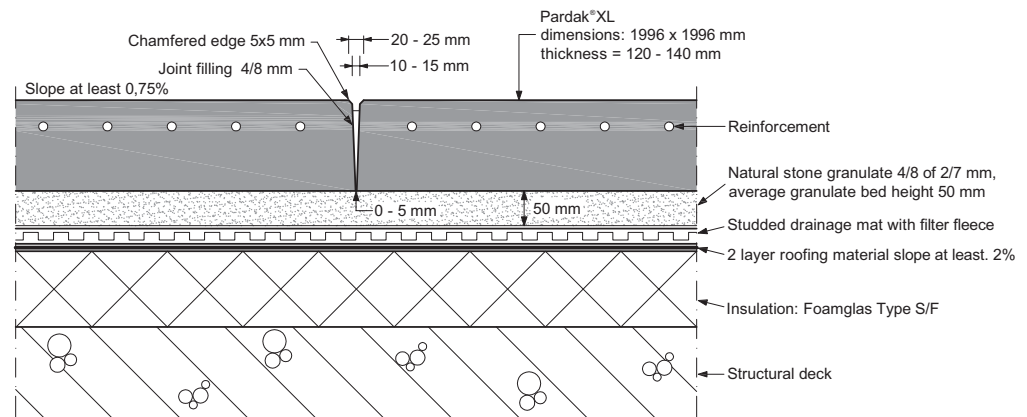
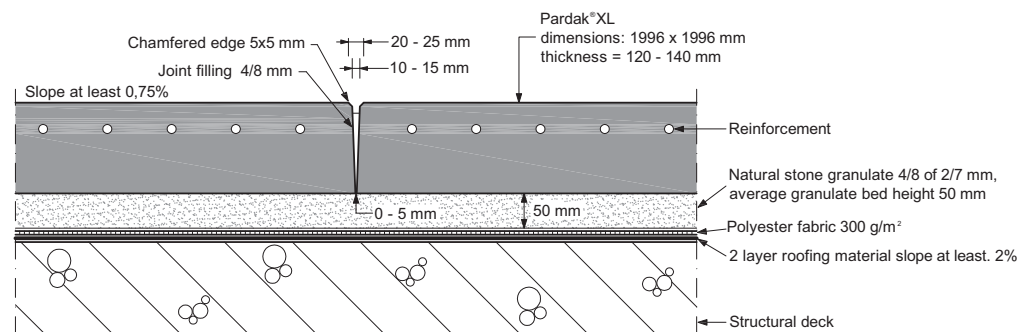


Figure 5 - Non-insulated roof Pardak® XL



10 Installation procedure

1 General Preparations

- perform all the work in accordance with the application instructions of the Agrément holder;
- check if all the structural work has been completed before starting the installation of the system; this also applies to any roofing, installation and painting work;
- visually check the underlying surface and in accordance with section 6 if required; in connection with responsibilities, record any deviations in a letter or e-mail message;
- sweep the surface of the roofing material on which the slabs are to be laid and remove any litter, sand, debris and other foreign materials;
- pay attention to colour differences in the slabs; report colour differences to prevent discussion afterwards;
- by starting the laying of the slabs, the underlying surface will be deemed as accepted; if the underlying surface is not OK, this shall be recorded in writing.

<p>10 Installation procedure (continued)</p>	<p>02 Checking</p> <ul style="list-style-type: none"> - check the underlying surface in accordance with section 7.1.1; - check if the correct Pardak® elements and accessories have been supplied and check the supplied slabs for damage. <p>03 Roofing material</p> <ul style="list-style-type: none"> - Install the roofing material in accordance with the instructions in section 7. <p>2 Thermal insulation</p> <p>01 General</p> <ul style="list-style-type: none"> - install the thermal insulation in accordance with the instructions in section 7. <p>02 Thermal insulation - inverted roof</p> <ul style="list-style-type: none"> - tightly join up the XPS boards individually and against edges and upstands without seams; this means that the rebates shall be removed at square connections; - XPS insulation boards that are square as standard shall remain that way; filling pieces shall be cut squarely using a circular saw with a guide; - the insulation material shall be protected from the effects of UV radiation; this means that the slab field surface shall be fully closed. <p>03 Thermal insulation - warm roof</p> <p>Note: Due to the required U-value for new developments (no greater than $0.18 \text{ W} \cdot \text{m}^2 \text{K}^{-1}$) and the relatively high thermal conductivity of Foamglas® S3 and F, the application of a Foamglas® insulation is only theoretically possible for new developments (required thickness 270 mm and 300 mm respectively), so it no longer is a logical choice.</p> <p>3 Pardak® 80 and Pardak® 110</p> <p>01 Laying plan</p> <ul style="list-style-type: none"> - record the dimensions of the surface to be installed and determine the slab distribution based on the effective width/length of the slabs; try to minimise the use of small slab pieces ($> 1/2$ slab) and prepare a laying plan, working symmetrically as much as possible; use the findings to determine in which corner of the roof it would be best to start, unless the building schedule opposes this; - maximise the use of whole Pardak® slabs on traffic lanes, at transitions from the ramp to the parking deck and above drains; use of filling pieces at entrance and exit ramps shall be prevented; use extended slabs in these locations and cut them to size if required; outside the traffic zones, e.g. on the external wall side or near rising surfaces on the railing side, smaller filling pieces may be used, as long as a proper connection is guaranteed; the laying of the slabs from a longer roof edge or building side shall always start with a row of whole slabs from a square corner; - one shall try to create long rows of parallel slabs, which continue squarely at corners of buildings; - discuss the laying plan with the site management and make arrangements about the transport and storage of the slabs and unhindered access to the location where the work will start. <p>02 Installation method</p> <ul style="list-style-type: none"> - the Pardak® 80 and Pardak® 110 Systems shall be installed by a subcontractor accredited by Zoontjens under the responsibility of Zoontjens; - place the pallets with the slabs at sufficient distance to distribute the load, ensuring that they are placed on concrete beams or columns of the structural deck if possible; - determine the locations of the slab intersections based on the slab laying plan and mark these locations by laying the slab supports there; - if a slab support overlaps with a roofing membrane overlap, fill up the unevenness with a bitumen filler piece to ensure that the slab support is flat on the surface; - place the Pardak® slabs using a vacuum laying machine on the pressure distributors with (for Pardak®) the cross-piece as a spacer and fill the slab support up with a bitumen filler piece in case of unevenness ($1/4$, $1/2$ or $1/1$); - place a Pardak® tensioning element at each slab corner; - fill the spaces in between the slabs and the rising walls with filling slabs and/or Granufix (mixture of rubber granulate and polyurethane resin); - after laying all the Pardak® slabs and filling up all the spaces in between, tension the slab paving in each section using two cycles, first 4N, then 8N. <p>4 Pardak® XL</p> <p>01 Laying plan</p> <ul style="list-style-type: none"> - see section 10.3.01. <p>02 Installation method</p> <ul style="list-style-type: none"> - the Pardak® XL System shall be installed by a subcontractor accredited by Zoontjens under the responsibility of Zoontjens; - the concrete slabs shall be stored on the roof in such a way that the structural deck is evenly loaded and the starting point is accessible; - once a sufficient surface has been laid, the supply and further laying of the concrete slabs shall be performed; - after laying all the concrete slabs, fill the joint at the upstands with round PE foam $\varnothing 40$ mm and Granufix®; the joints left at upstands and edges shall be at least 40 mm wide; where required, cut the concrete slabs to size; the Granufix® polyurethane-bonded rubber mortar is supplied in batches and shall be prepared right before its application; 	
<p>Version 01</p>	<p style="text-align: center;">Expert Centre Building Envelope Copyright© 2017 Kiwa BDA</p>	<p>Page 11 of 12 pages</p>

<p>10 Installation procedure (continued)</p>	<ul style="list-style-type: none"> - install the Pardak® XL concrete slabs in accordance with the laying plan using a vacuum laying machine in a tight English bond with joints of no more than 5 mm at the bottom, creating joints of no more than 25 mm wide on the chamfered edge due to the tapered shape of the slab edges; - fill the joints with natural stone granulate 4/8 mm by brushing in step by step.
<p>11 Building Regulations</p>	<p>1 Requirements: The Building Regulations 2010 and subsequent amendments</p> <ul style="list-style-type: none"> - B4(2) External fire spread - the use of the Systems on one of the supporting structures prescribed in Approved Document B, Table A5, part iv, will enable a roof to be unrestricted under this Requirement; see section 6.3.06 of this Agrément; - C2(b) Resistance to moisture - the Systems will contribute to limiting the risk of surface and interstitial condensation; see sections 6.3.02, 6.3.04, 7 and 8 of this Agrément; - Regulation 7 Materials and workmanship - Pardak® Systems are manufactured from suitably safe and durable materials for its application and can be installed to give a satisfactory performance, see section 10 of this Agrément. <p>2 Requirements: The Building (Amendment) Regulations 2014 (Wales) and subsequent amendments</p> <ul style="list-style-type: none"> - B4(2) External fire spread - the use of the Systems on one of the supporting structures prescribed in Approved Document B, Table A5, part iv, will enable a roof to be unrestricted under this Requirement; see section 6.3.06 of this Agrément; - C2(b) Resistance to moisture - the Systems will contribute to limiting the risk of surface and interstitial condensation; see sections 6.3.02, 6.3.04, 7 and 8 of this Agrément; - Regulation 7 Materials and workmanship - Pardak® Systems are manufactured from suitably safe and durable materials for its application and can be installed to give a satisfactory performance, see section 10 of this Agrément. <p>3 Requirements: The Building (Scotland) Regulations 2004 and subsequent amendments</p> <p>3.1 Regulations 8 (1)(2) Durability of materials and workmanship</p> <ul style="list-style-type: none"> - Pardak® Systems are manufactured from acceptable materials and are considered to be adequately resistant to deterioration and wear under normal service conditions, provided they are installed in accordance with the requirements of this Agrément; see section 10 of this Agrément. <p>3.2 Regulation 9 Building Standards-Construction</p> <ul style="list-style-type: none"> - 2.8 Spread of fire from neighbouring buildings - the use of the Systems will not affect the fire rating obtained by flat roofs with continuously supported coverings when evaluated by assessment or test to BS 476-3:2004¹⁷, see section 6.3.06; - 3.10 Precipitation - the Systems will contribute to limiting the risk of passage of moisture; see sections 6.3.02, 6.3.04, 7 and 8 of this Agrément; - 7.1(a)(b) - Statement of sustainability - the blocks can contribute to satisfying the relevant Requirements of Regulation 9, Standards 1 to 6, and therefore will contribute to a construction meeting a bronze level of sustainability as defined in this Standard; in addition, the concrete slabs of the Systems can contribute to a construction meeting a higher level of sustainability as defined in this Standard; see sections 7 and 8 of this Agrément. <p>3.3 Regulation 12 Building Standards-Conversions</p> <p>All comments given for the Systems under Regulation 9 also apply to this Regulation, with reference to clause 0.12 and Schedule 6 of this Standard.</p> <p>4 Requirements: The Building Regulations 2012 (Northern Ireland) and subsequent amendments</p> <ul style="list-style-type: none"> - 23(a)(i)(iii)(b) Fitness of materials and workmanship - the Systems are manufactured from materials which are considered to be suitably safe and acceptable for use as parking decks as described in sections 7 and 8 of this Agrément; - 28(b) Resistance to moisture and weather - the Systems can be constructed so as to prevent any harmful effect on the building or the health of the occupants caused by the passage of moisture to the building from the weather; - 36(b) External fire spread - the use of the Systems will not affect the fire rating obtained by flat roofs with continuously supported coverings when evaluated by assessment or test to BS 476-3:2004¹⁷, see section 6.3.06.
<p>12 NHBC Standards</p>	<p>In the opinion of the Kiwa BDA Expert Centre Building Envelope (ECBE), the Pardak® 80, Pardak® 110 and Pardak® XL Systems, if installed, used and maintained in accordance with this Agrément, can satisfy or contribute to satisfying the relevant requirements in relation to NHBC Standards² Chapter 7.1 Flat Roofs and Balconies.</p>
<p>Version 01</p>	<p style="text-align: center;">Expert Centre Building Envelope Copyright© 2017 Kiwa BDA</p>
	<p style="text-align: right;">Page 12 of 12 pages</p>