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	TECHNICAL ACCREDITATION WITH CERTIFICATION
	FIXINOX 3D Suspension system for connecting panels Fixinox Sprl Rue Albert 1er, 35A 6220 LAMBUSART Tel: 071/81.05.26 Fax: 071/81.05.29 e-mail: fixinox@wanadoo.be

DESCRIPTION

5.2

External building materials - structural work

1. Subject

Fixing system, adjustable in three directions, designed for fixing prefabricated facing panels in reinforced concrete with a minimum thickness of 8 cm to a structure in concrete or metal (see Appendix 1).

A ventilated cavity for possible heat and/or acoustic insulation is created behind the prefabricated panels.

The system is in austenitic stainless steel and arranged in pairs per panel, it comprises:

- An upper part with a hole for fitting the Fixinox 3D to the carrying structure by means of mechanical expansion bolts in stainless steel having a European Technical Accreditation (ETA);
- A lower part to be fitted into the facing panel;
- A pivot pin, which is used for lateral adjustment;
- A suspension eye pin, allowing vertical adjustment.

Additional parts which complete the system:

- A connecting pin
- Spacers
- Anti-wind fittings
- Clamping devices

The accreditation is for the device comprising the defined materials, including the implementation technique, but is not for the quality of execution.

The accreditation with certification comprises internal control of the manufacture, and a periodic external control.

Products receiving a certificate of compliance with this accreditation can be exempted from technical reception trials prior to being put into use.

The Fixinox company manufactures (?) and markets the product, and can offer technical assistance to users.

2. Materials:

The four parts of the fixing system are in austenitic stainless steel:

- EN 10.088 – Stainless 316

- Insert base plates and strips: manufactured from sheet metal.

Yield point $R_{p0.2}$: 300 N/mm²
Tensile strength R_m : 500 N/mm²

- Pin and eye pin: from threaded rod or cold drawn bar

Non-threaded part

- Yield point $R_{p0.2}$: 240 N/mm²
- Tensile strength R_m : 500 N/mm²

Threaded part:

- Yield point $R_{p0.2}$: 350 N/mm²
- Tensile strength R_m : 700 N/mm²

- Bolts: from A4 steel in accordance with DIN 934 CA4

Connection between the components such as hammerhead bolts, nuts, threaded rods.

- Pair of strips in the prefabricated panel: high-adhesion steel

These bars are not supplied by Fixinox. They must meet the following requirements: E500-3 (R_e : 500 N/mm², A_{min} : 5%).

Non-stressed components: in plastic

Plastic sleeves: Hard PVC (for spacer)
Pin sleeves: PE
Recess unit: EPS

3 Components of the suspension system

There are 4 types of fitting to choose from, according to the service limit load: 11.5 kN, 22 kN, 27 kN and 34 kN. They are identified by a colour marking.

The dimensions of the various components described below can be found in the appendix along with a drawing of the suspension system.

3.1 Base plate (Appendix 2)

The base plate is fitted to the carrying structure by means of an expanding bolt, a chemical anchorage or bolting, sized according to the applicable loads.

The base plate is made up of a strip from stainless steel sheet, the lower part of which is punched into a tube shape for the eye pin to pass through, and the upper part of which is cut into a notch. The base plate can be doubled if necessary to distribute the load over two through bolts.

3.2 Suspension eye pin (Appendix 3)

The eye pin is connected to the insert plate and helps vertical adjustment. The eye pin is crossed by a cylindrical pin that allows the connection with the insert.

The diameter of the pin is according to type. One of the ends is threaded for height adjustment and is inserted into the lower part of the base plate. The other end, non-threaded, is welded into the form of an eye so as to hold the connection pin for lateral adjustment.

The threaded part is fitted with a nut and washer which must be lubricated so as to avoid a cold junction (seizing) during adjustment whilst the suspension system is under stress.

3.3 Insert (Appendix 4)

The insert is made up of a pair of strips connected by a welded peg and a recess unit in expanded polystyrene. This insert is completely covered by the prefabricated component.

The two strips are folded on the upper part so as to remain in alignment with the eye pin. One of the two strips has a flat lug designed to lock the connecting pin. This welded assembly will be anchored vertically inside the prefabricated unit by means of two BE500 steel armatures (concrete iron) passed across the two strips. In addition a reinforcing armature will be placed to the right of the fold in the strips.

3.4 Spacer-cylinders (Appendix 5)

The spacers are fitted in the immediate vicinity of the insert. They are designed to transmit compression forces to the carrying structure.

Each spacer is made up of a threaded rod or bolt onto which is welded a distribution plate forming a support head. The diameter of the rod depends on the admissible load of the suspension system associated with the wind strength to be balanced and the distance between the structure and the prefabricated facing panel (see table x). The threaded rod is inserted into a cylindrical-sectioned flanged PVC sleeve, incorporated into the panel or into the structure.

Two spacers can be placed on the lower part in place of wind anchor points if the component is not at risk of coming apart from the support in high winds.

3.5 “Wind” anchorages (~~Appendix 6~~)

The “wind” anchorage takes the traction and compression stresses due to the weight of the component being suspended, and the wind. There are three types and are to be chosen according to the situation:

The choice of “wind” anchorage depends on the support, the location of the architectonic component compared to the support, on what the support is to be used for, and what is usually done by the installer.

3.5.1 Compression “wind” anchorage (Appendix 5)

The compression wind anchorage is made up of a polyethylene sleeve sealed in the structure or in the facing panel. This “wind” anchorage can only take compression stress. It resembles the spacer-cylinder.

3.5.2 Rail “wind” anchorage (Appendix 6)

The principle of the rail “wind” anchorage is to connect two rails with welded lugs sealed on the respective sides of the structure and panel on the inside of the ventilated space, both rails being orthogonal.

The adjustable connection, for position and length, can be done in various ways, all of the parts always being in stainless steel.

a) Connection by turnbuckle

Connection and adjustment by means of a screw nut system comprising two hammer-head screws, one with a left-hand thread, the other with a right-hand thread, and a coupler, one end of which has a right-hand thread, the other a left-hand thread.

b) Connection by flat parts with racks or serrations, or by "grids"

Connection and adjustment by means of two flat parts with racks ("grids"), held within the rails by notches or hammerhead screws fixed to the flat part by welding.

c) Connection on the edges

Connection on the edges is by two rails sealed respectively on the edge in the structure, perpendicular to the façade and in the panel parallel to the façade. They are connected by a flat part fixed on the structure's rail by means of a hammerhead bolt and to the panel's rail by means of a hammerhead bolt or a notch in the plate.

3.5.3 “Wind” anchorage by sleeve and through bolt (expanding bolt) (Appendix 7)

“Wind” anchorage by sleeve and through bolt is by a plate fitted with an open oblong hole on the lower part and a hole on the upper part. This plate is fixed across the hole by means of a through bolt and kept away from the concrete by a ring welded to the back of the plate. A screw passes through the oblong hole and is fixed to the facing panel by means of a sleeve sealed in the concrete. The diameter of the ring is equal to the thickness of the screw head.

3.6 Pinning (Appendix 8)

Pinning makes two superimposed panels solid by means of a pin sealed in the edge of the two panels. They are usually made up of:

- A hollow cylindrical sleeve in polyethylene, sealed on the **lower** edge of the **upper** panels;
- An oval-section polyethylene sleeve sealed on the **upper** edge of the **lower** panel, the large size of the section being parallel to the façade;
- A stainless steel pin with a diameter equal to the interior diameter of the cylindrical sleeve (single pinning);

The **oval** sleeve of the lower panel has a larger diameter; a complete seal of the pin in the mortar is therefore made (sealed pinning).

The pin can be connected to the structure by means of a threaded rod anchored into the structure by a mechanical expanding bolt (additional pinning) or by one of the systems described in paragraph 2.1.5. (??)

4. Manufacture and marketing

4.1 Manufacture:

The various components of the fixing system are manufactured by Fixinox in its factory at Rue Albert 1^{er},35A at 6220 Lambusart, Belgium, or subcontracted according to the terms and conditions.

All the items making up the fixing system (kit), described in paragraph 3 are supplied by Fixinox.

Internal control of the manufacturing process includes control of raw materials, control of the manufacturing process and control of the finished parts.

4.2 Identification

The base plate, eye pin, cylindrical pin and the polystyrene housing are identified by a colour which shows the classification of service load limit. All of the suspension systems have been standardised according to 4 load categories:

Load categories (kN)	Colour marking
11.5	Green
22	Yellow
27	Blue
34	Orange

5. Implementation

The planning department must determine and/or prescribe, according to the types of forces:

- the type of suspension system
- the position of the fittings and accessories
- the arrangement of reinforcing steel in sailcloth panels.

It is the responsibility of the manufacturer of the panels and of the contractor to use only a specialised workforce with the equipment, and to ensure, by regular checks, that at all times and in all areas of the workplace the work is carried out following the specifications of accreditation and of the manufacturer of the fittings. The contractor must also verify that the structure is suitable for bearing the stresses generated by the panels and the manufacturer of the panels must ensure the quality of the concrete in the covering panel according to the type of exposure.

5.1 Manufacture of the facing panels

Precondition: the concrete panels must satisfy PTV212: “prefabricated wall components in reinforced concrete and pre-stressed concrete”.

During manufacture of the panels, two suspension systems are used per panel, in the quarter of the length from the vertical edges. The choice of model of suspension system is determined according to the weight of the component to be suspended and the admissible load of the suspension system.

The insert is fitted together with the polystyrene housing and is designed to be held in contact with the corresponding surface. Concrete bars (Appendix 10) are slid into the insert strips so as to anchor the insert to the concrete. They are held in place by a number of shims and their level orientation and position is ensured by a rigid device linked to the mould. Their dimensions are determined in the corresponding table.

At 15 cm from each suspension system, a spacer sleeve and pin is incorporated if necessary, at the foot and at the head, by fixing them to the sides of the formwork. The concrete around the sleeve pins must be reinforced by coiled binding in stainless steel when the thickness of the concrete panels is not sufficient to allow them to provide a nominal coating of 3 cm on each of the sides of the facing panel. At the corner of the building, a wind anchorage is used in the rod of each pin.

5.2 Fixing the facing panels to the structure

Fixing the prefabricated components can only take place where the compressive strength of the structure's concrete and the facing panels' concrete is at least equal to 25Mpa and where the compressive strength of the structure's concrete is at least equal to that stated in the ETA relating to the associated metal through bolts in stainless steel.

The nominal incline of the stays to the vertical is 20°(18° and 22°).

The maximum allowances for adjustment is as follows:

- Vertical direction: ± 30 mm by tightening the nut holding the base plate;
- Sideways direction: ± 20 mm, by moving the eye pin over the cylindrical pin;
- Distance from the support: ± 30 mm, with spacers

Fitting a panel is carried out according to the following operations:

1. Positioning the pinning system:
 - Either by sealing the stainless steel threaded rods in the holes bored into the concrete of the structure in places defined beforehand following the instructions,
 - Or by expansion of the metal bolts.
2. Preparation of the facing panels:
 - Remove the expanded polystyrene housings, where used,
 - Insert cylindrical pins and eye pins,
 - Insert screws and spacers in their sleeve (adjustment to the theoretical dimension) and wind anchorages in the rails,
 - Bolt the base plates to the eye pins,
 - Fasten the safety panel by folding.
3. Lifting and fixing the facing panel:
 - Position the panel according to the instructions,
 - Insert, where used, pins of the lower component into the sleeves of the component to be fitted

- Position the base plates on the through bolts where the structure is to be fitted, and tighten the fixing bolts. Where the suspension system is to be fitted to a metal support, the through bolt is replaced by a bolt.
 - Adjust vertically using the eye pin.
4. The hoist is now free.
 5. Depth adjustment of the facing panels
By tightening the holding nuts of the intermediary parts and on the spacers for holding it perpendicular to the facing plate, and on the wind anchorages where used.

- Wind anchorage:

In the case where the component may be subject to wind stresses, two wind anchorages must be fitted in place of the lower spacers.

In order to determine whether the component may be subject to this stress, all that needs to be done is to calculate the resultant moment of the weight and wind stresses compared to the position of the through bolt, taking into account the specifications of the NBN ENV 1991-2-4 standard with a return period of 50 years.

- Thermal expansion:

As the components are suspended completely independent of each other, the components are able to expand. In addition, where a component is fitted to another by pinning, expansion is allowed by the sliding of the pin in the round PVC tube.

6. Specifications:

6.1. Tensile strength of the panel and suspension system

Direction traction tests have been carried out on the combination of the **base plate** and **eye pin**. Three tests have been carried out per type of suspension system. In all cases, breakage occurred around the **base plate**.

Table: tensile strength of plate and suspension system

Service load limit (kN)	Breaking load kN	Variation type kN	Safety factor	Type of break
11.5	43.67	0.98	3.8	On the upper surface of the panel Plastic buckling of the threaded rod
22	76.00	4.06	3.6	
27	79.47	7.74	2.9	
34	90.7	7.14	2.7	

6.2 Pin

The loads to be taken by the pin are determined by the calculation:

Yield stress $R_{e0.2} = 240 \text{ N/mm}^2$

Safety factor γ_m : 1.1

Admissible stress: 218 N/mm^2

Pin	Diameter (mm)	Length (mm)	Calculated stress (N/mm²)
11.5	24	87	183.30
22	24	95	188.82
27	32	102	195.29
34	36	114	182.78

6.3 Strips

The loads to be taken by the strips are determined by the calculation:

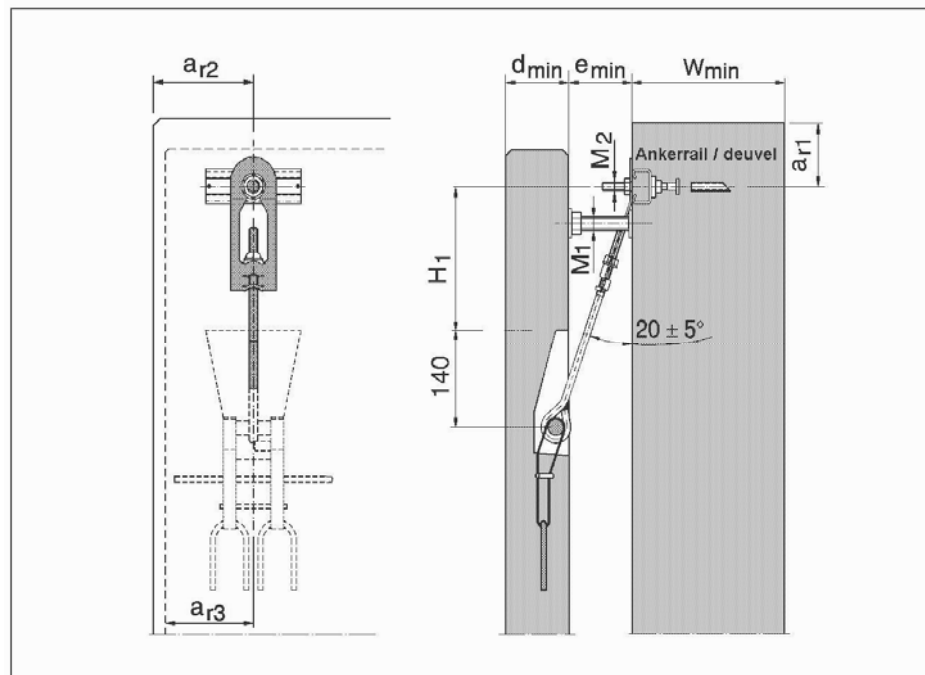
Yield stress $R_{e0.2} = 300 \text{ N/mm}^2$

Safety factor γ_m : 1.1

Admissible stress: 273 N/mm^2

Strips	Length (mm)	Thickness (mm)	Calculated stress (N/mm²)
11.5	18	2	188.4
22	20	3	207.5
27	25	3	196.1
34	30	3	197.6

Appendix 1: general outline of the FIXI 3D + layout of the FIXI 3D + dimensions for implementation



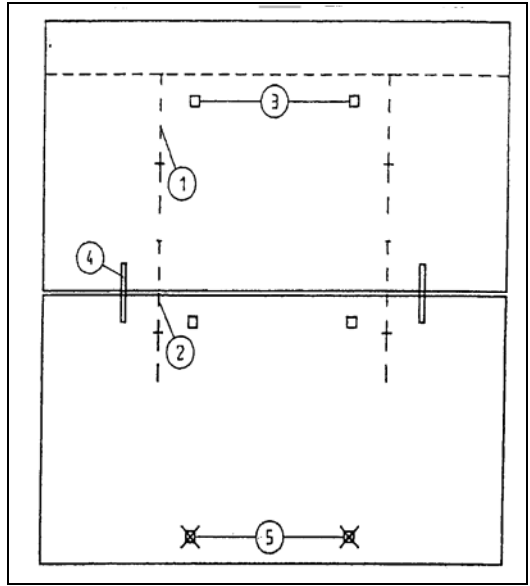
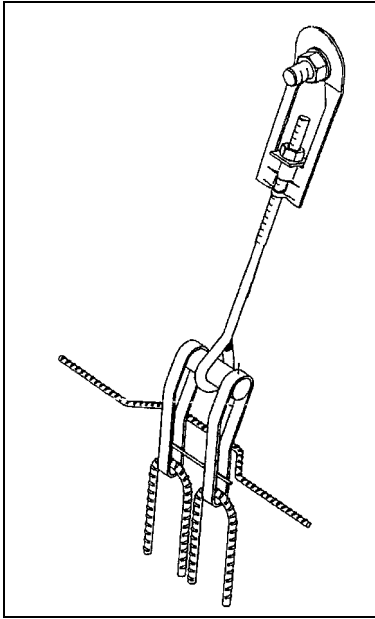
Wt. Cat. kN	d _{min} mm	e _{min} mm	W _{min} mm rail/th. bolt	H ₁ mm	Rail type	Through bolt type	M ₁ mm	M ₂ mm rail/th. bolt	a _{r1} mm rail/th. bolt	a _{r2} mm rail/th. bolt	a _{r3} mm
11.5	80	60	190/200	$\frac{(e+20)}{\tan 20^\circ} - 130.4$	54/33	M16 A4	According to App. 5	16/16	200/160	250/160	190
22	90	80	220/220	$\frac{(e+20)}{\tan 20^\circ} - 129.4$	72/49	M20 A4		20/20	250/200	300/200	220
27	100	80	---/220	$\frac{(e+20)}{\tan 20^\circ} - 128.9$	---	M20 A4		---/20	---/200	---/200	240
34	100	80	---	$\frac{(e+20)}{\tan 20^\circ} - 126.4$	According to static calculation					260	

View of the suspension system

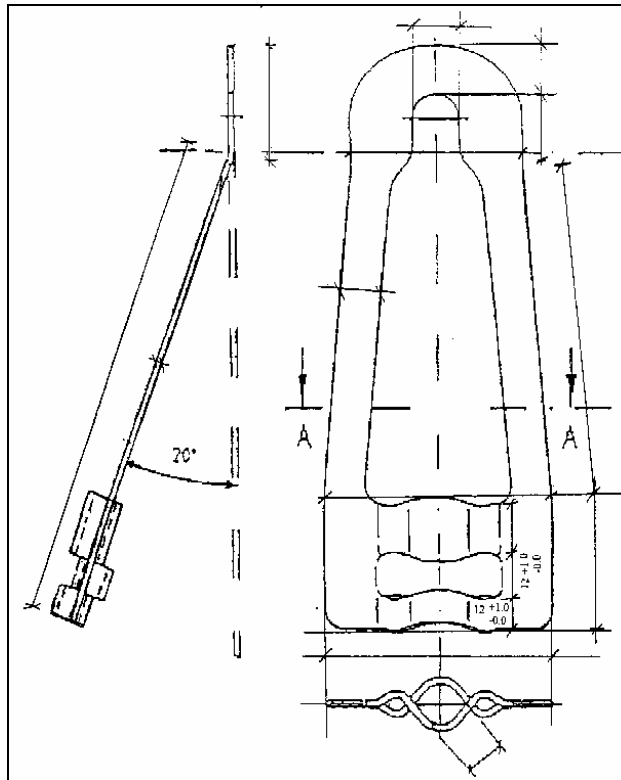
Example of the 2 architectonic panel system:

1. Susp. System 2. Susp. System 3. Spacer 4. Pinning 5. Wind

Anchorage

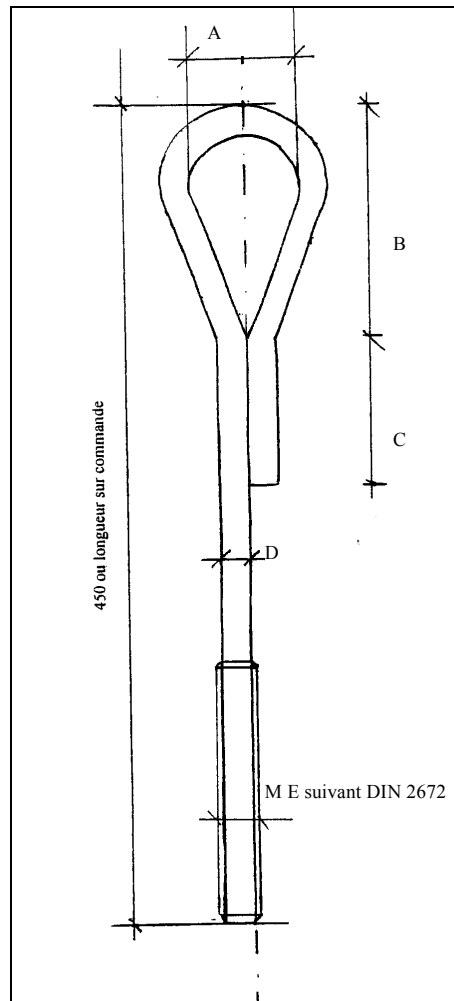


Appendix 2: The Base plate



DIMENSIONS OF THE BASE PLATE (mm)														
Type	A	B	C	D	E	F	G	H	I	J	K	L	M	Colour
error	+1.0 -1.0	+0.24 -0.24	+1.0 -0.0	+1.0 -1.0	+1.0 -1.0	+1.0 -0.0	+1.0 -1.0	+1.0 -1.0	+1.0 -1.0	+1.0 -1.0	+1.0 -1.0	+1.0 -0.0	+1.0 -0.0	
11.5	133	3	15	71	45	13.5	22	23	84	47	73	20	14	Green
22.0	175	4	18	90	45	18	22	23	122	51	92	25	18	Yellow
27.0	174	4	20	93	50	21	22	28	120	57	89	30	20	Blue
34.0	175	4	24	100	64	21	35	29	106	68	100	41	23	Orange

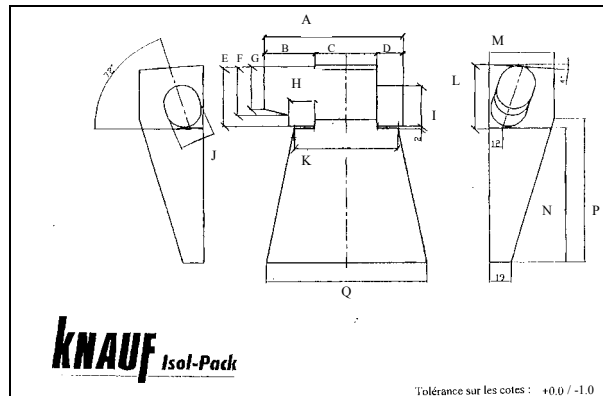
Appendix 3: Suspension Eye Pin



DIMENSIONS OF THE EYE PIN (in mm)						
Type	A	B	C	D	E	Colour
erreur	+1.0 -0.0	+1.0 -1.0	+1.0 -1.0	+1.0 -0.0	M	
11.5	28	55	45	10.9	12	Green
22.0	38	60	45	14.6	16	Yellow
27.0	39	85	40	16	18	Blue
34.0	40	80	45	18	20	Orange

Appendix 4: Insert

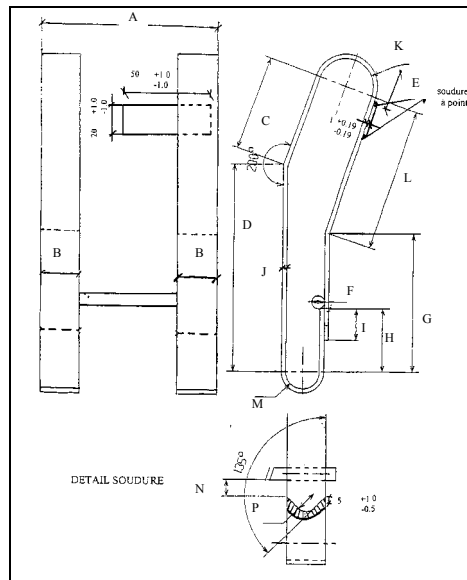
Recessed component



DIMENSIONS OF THE INSERTS (in mm)

Type	A	B	C	D	E	F	G	H	I	J	K	L	M	N	P	Q	Colour
Error	+0.0 -1.0	+0.0 -1.0	+0.0 -1.0	+0.0 -1.0	+0.0 -1.0	+0.0 -1.0	+0.0 -1.0	+0.0 -1.0	+0.0 -1.0	+0.0 -1.0	+0.0 -1.0	+0.0 -1.0	+0.0 -1.0	+0.0 -1.0	+0.0 -1.0	+0.0 -1.0	
11.5	119	44	54	21	50	40	32	21	30	25	95	55	54	120	128	146	Green
22.0	125	44	57	24	55	45	39	24	38	32	95	59	60	120	128	146	Yellow
27.0	131	51	52	28	81	68	60	28	40	34	110	86	60	117	130	150	Blue
34.0	150	66	52	32	78	68	60	32	49	37	110	86	60	117	130	150	Orange

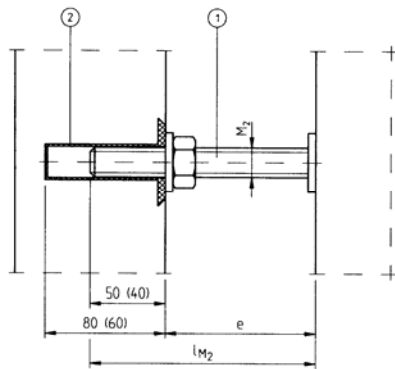
The Strips



DIMENSIONS OF THE STRIPS (in mm)

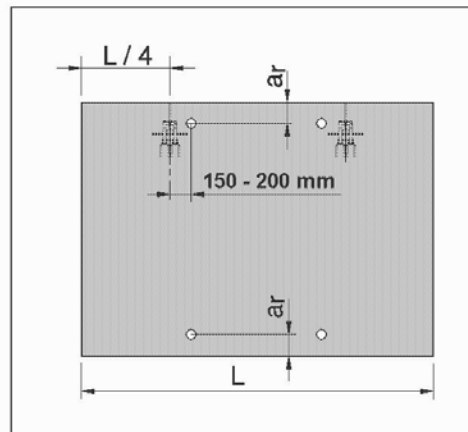
Type	A	B	C	D	E	F	G	H	I	J	K	L	M	N	P	Colour
erreur	+1.0 -1.0	+1.0 -0.0	+1.0 -1.0	+1.0 -1.0	+1.0 -1.0	+0.01 -0.01	+1.0 -1.0	+1.0 -0.0	+1.0 -1.0	+0.22 -0.22	+0.5 -0.5	+1.0 -1.0	+0.5 -0.5	+0.5 -0.5	+0.5 -0.5	
11.5	90	18	44	97	17	6	65	18	9	2	26	66.5	16	8.1	10	Green
22.0	95	20	55	88	32	6	42	32	15	3	34	85	18	10	10	Yellow
27.0	105	25	69.5	82.5	35	6	60	16.5	14	3	35	86.5	27	7	13	Blue
34.0	114	30	64.5	110	35	6	57	24	21	3	39	105.5	28	6.5	13.6	Orange

Appendix 5: The Spacer:



1. Compression spacer
2. Round PVC sleeve

The dimensions and location of the spacers are shown below:



The gap behind is shown in the table below:

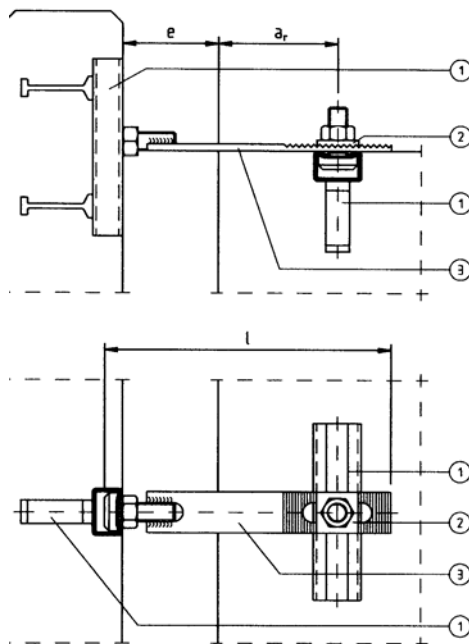
	M12			M16			M20		
d_{\min}	70	90	100	80	90	120	90	100	140
$e(\text{mm})$	COMPRESSION FORCE $F_{d_{\max}}$ (kN)								
60	14	17.5	24	19.5	24.5	38.5	26.5	31	48.5
80	14	17.5	18.5	19.5	24.5	38.5	26.5	31	48.5
100	13	13	13	19.5	24.5	33.5	26.5	31	48.5
120	8	8	8	19.5	24	24.	26.5	31	48.5
140	8	8	8	19.5	24	24.	26.5	31	48.5
160	---	---	---	18.5	18.5	18.5	26.5	31	38.5
180	---	---	---	13	13	13	26.5	31	38
200	---	---	---	13	13	13	26.5	31	33.5
$a_r \geq$	70	70	110	100	120	170	135	150	200

The choice of spacer (M2) depends on the service load and the panel-wall gap and is described in the following table:

e(mm) Weight type (kN)	40	60	80	100	120	140	160	180	200
34.0							M24		
27.0					M20				
22.0		M16							
1.5		M12							

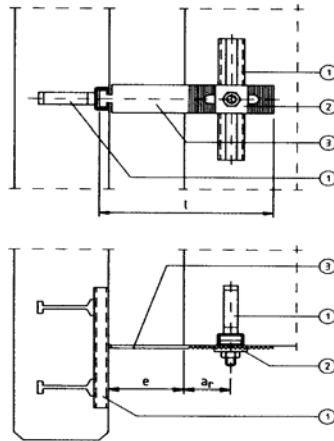
Appendix 6: Wind Anchorage

With welded and serrated anchor head for traction and compression



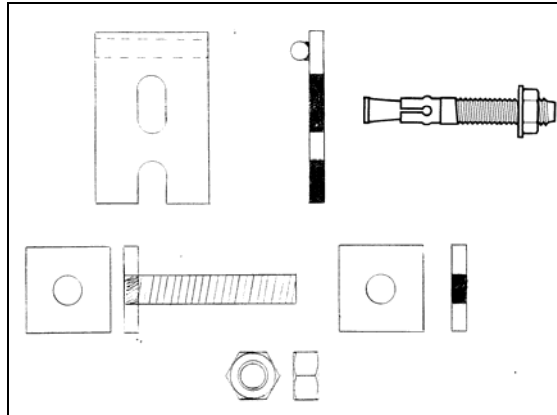
Position	8 kN type (pressure – stress)	12 kN type (pressure – stress)
1	Anchorage rail, type 40/25/150	Anchorage rail, type 49/30/150
2	Anchor bolt head M16x40 type 40/22 With serrated plate 30x30x4 mm	Anchor bolt head M16x40 type 40/22 With serrated plate 30x30x4 mm
3	Serrated wind anchorage 35 x 6 mm (max e = 90 mm) or 35/8 with welded anchor head L = e+160 (mm)	Serrated wind anchorage 35 x 8 mm with welded anchor head L = e+135 (mm)
e	Maximum e = 220 mm	
Back	50 mm	75 mm

Wind anchorage with embossed serrated head for traction and compression



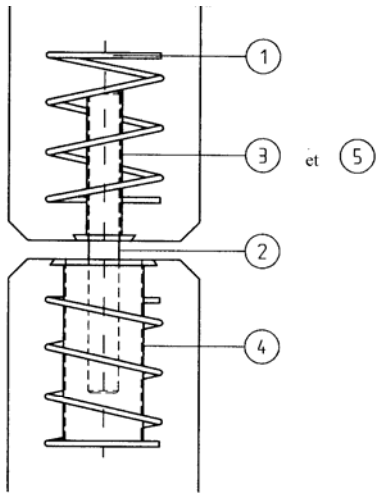
Position	Type 3.5 kN (pressure-stress)	Type 5.5 kN (pressure-stress)	Type 7.0 kN (pressure-stress)
1	Anchorage rail, type 28/15/150	Anchorage rail, type 38/17/150	Anchorage rail, type 38/17/15
2	Hammerhead bolt M10x30 type 28/15 With serrated plate 30x30x4 mm	Hammerhead bolt M12x30 type 38/17 With serrated plate 30x30x4 mm	Hammerhead bolt M12x30 type 38/17 With serrated plate 30x30x4 mm
3	Serrated wind anchorage 35 x 4 mm $L = e+110$ (mm)	Serrated wind anchorage 35 x 5 mm $L = e+135$ (mm)	Serrated wind anchorage 35 x 5 mm $L = e+135$ (mm)
e	e maximum 120 mm		
ar	50 mm	75 mm	75 mm

Appendix 7: Wind anchorage by sleeve and through bolt (expanding bolt)



Appendix 8: Pinning

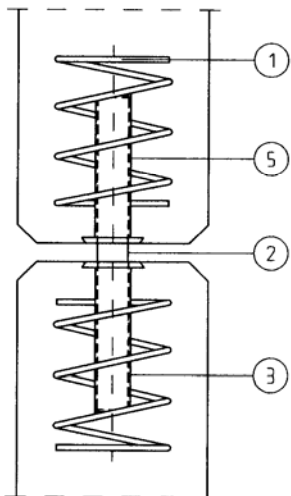
Sealed pinning



1. Coil, 60 x 80 mm
2. Pin \varnothing 16 x 170 mm
 $Q_{max} = 4.4kN$
 Or
 Pin \varnothing 20 x 170 mm
 $Q_{max} = 4.4 kN$
3. Round PVC sleeve
 16.5 x 80 mm
4. Oval PVC sleeve
 22 x 47 x 100 mm

Fig 16

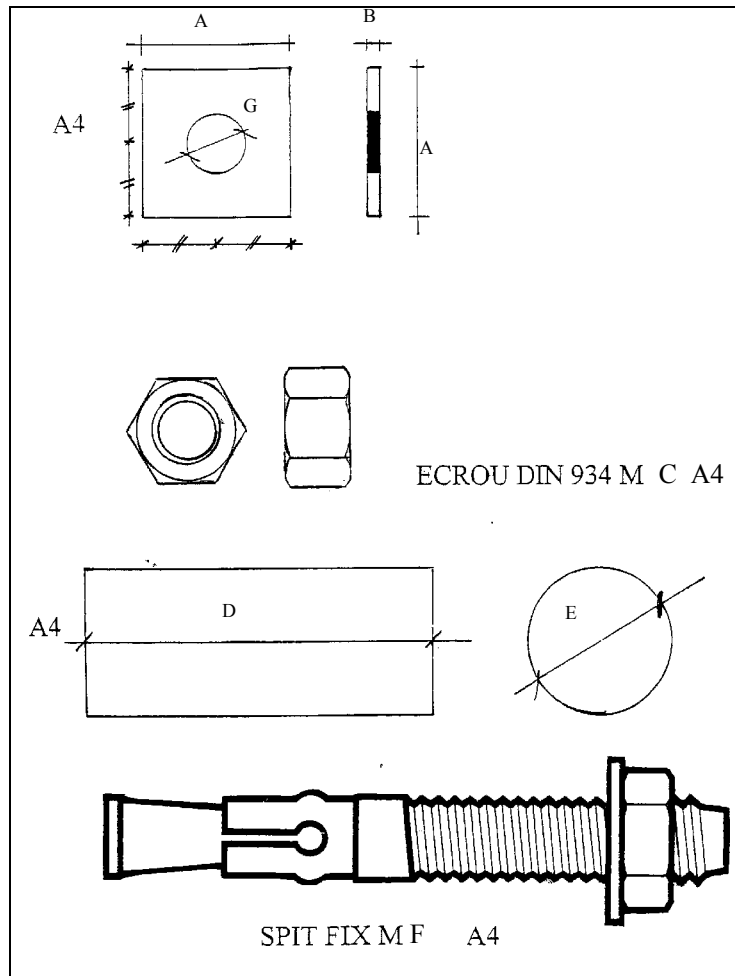
Dry pinning



5. \varnothing 16.5 x 80 mm
 Variant 20.5 x 80 mm

Fig 17

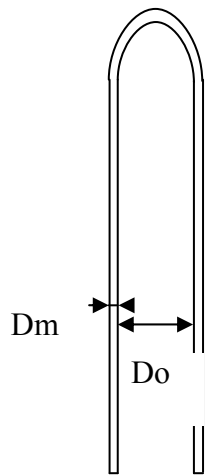
Appendix 9: accessories for the suspension device



DIMENSIONS OF THE ANCHORAGES (mm)								
Type	A	B	C	D	E	F	G	Colour
Error	+1.0 -1.0	+0.24 -0.24	M	+1.0 -1.0	+0.01 -0.01	M	+0.5 -0.5	
11.5	24	4	12	87	24	12	12.5	Green
22.0	32	4	16	95	30	16	18	Yellow
27.0	32	4	18	102	32	20	18	Blue
34.0	34	5	20	114	36	20	20	Orange

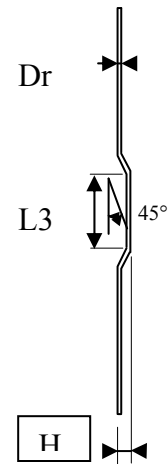
Appendix 10: Concrete armatures

Anchoring armatures



Total length L1

Reinforcing armatures



Total length L2

Type	Minimum thickness	L1 (mm)	Do (mm)	Dm (mm)	L2 (mm)	Dr (mm)	L3 (mm)	H (mm)
11.5 kN	80	280	40	8	450	Φ 6	97	30
22.0 kN	90	400	50	10	570	2 Φ 6	105	40
27.0 kN	100	460	50	10	520	2 Φ 8	112	50
34.0 kN	100	470	60	12	630	2 Φ 8	124	50