





FERCANORTE

ESTRUTURAS, LAJES E COFRAGENS, LDA. | MK4

PRODUCTS

- POST-TENSIONING
- SUPPORT BEARINGS
- FERCA MOULDS
- NAUTILUS BLOCKS
- FERCA BLOCKS
- POST-SHORING
- CUPOLEX
- WATERPROOFING



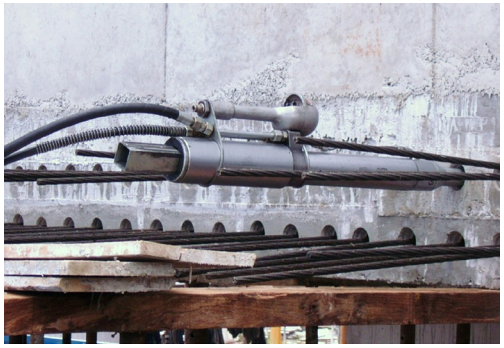


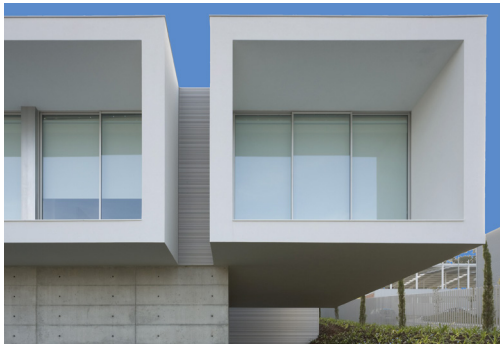
PRODUCT CATALOG

PT AO MZ











TECHNICAL SUPPORT

- STRUCTURAL VERIFICATION
- STRUCTURAL MODELING
- APPLICATION PROJECT
- ALTERNATIVE SOLUTIONS
- ECONOMICAL STUDY
- COMPATIBILIZATION



PRESENTATION

Fercanorte - Structures, Slabs and Formworks Ltd is an engineering company that has dedicated all its efforts to structural concepts that allow the realization of slabs solutions, using techniques and products in order to satisfy the quality standards as well as structural and architectural features, with advantageous and competitive final costs against other structural solutions.

As so, the beginning of its activity was immediately focused on the introduction of flat slabs solutions without beams, which allowed the combination of essential and crucial factors to the acceptance by designers, architects, contractors and project owners of this solution.

These solutions were first implemented using lightweight blocks, fungiblocos, and then with recoverable plastic molds, thereby reaching the requirements of simplicity and and speed of execution of formwork and placement of rebar in structural meshes that allowed the use of multipurpose spaces for parking, commercial and residential areas.

In addition, the introduction and promotion of post-tensioning in buildings since 1982, providing solutions in prestressed reinforced concrete, associated with various structural slab solutions, has expanded its field of action and intervention, allowing the meeting of even higher architectural and structural requirements, and ensuring at the same time the proper functionality of these structures in accordance with regulatory requirements.

Fercanorte is also present in the Angola and Mozambique markets.

In Angola, and in the short term also in Mozambique, Fercanorte extended its range of activities, in partnership with specialized companies in the field of waterproofing and protection of buried structures in contact with water, representing the CETCO with VOLTEX products (sodium bentonite expansive membrane) and in the field of metal-textile tensioned shades.

FERCANORTE ESTRUTURAS, LAJES E COFRAGENS, LDA. | MK4

ANGOLA
FERCANORTE ENGENHARIA E EMPREENDIMENTOS, LDA. | MK4

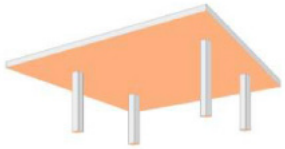
FERCAMOÇ ENGENHARIA, LDA. | MK4

SLAB STRUCTURAL SOLUTIONS

The mostly used structural solutions for lightened slabs in buildings, either using post-tensiong or not, among the wide array of FERCANORTE commercialized products may be schematically presented as follows:

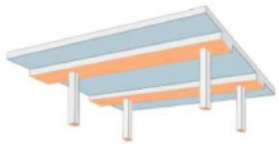
FLAT SLAB

reinforced concrete or post-tensioned reinforced concrete



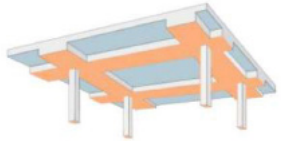
ONE WAY SLAB

reinforced concrete or post-tensioned reinforced concrete



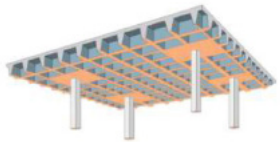
TWO WAY SLAB

reinforced concrete or post-tensioned reinforced concrete



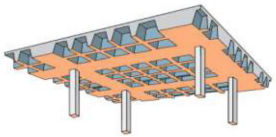
WAFFLE SLAB

reinforced concrete or post-tensioned reinforced concrete



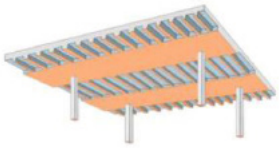
WAFFLE SLAB WITH BANDS

reinforced concrete or post-tensioned reinforced concrete



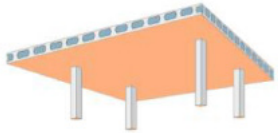
ONE WAY JOIST SLAB WITH BANDS

reinforced concrete or post-tensioned reinforced concrete



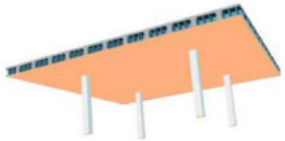
VOIDED SLAB WITH NAUTILUS

reinforced concrete or post-tensioned reinforced concrete



VOIDED SLAB WITH FERCANORTE BLOCKS

reinforced concrete or post-tensioned reinforced concrete



POST-TENSIONING

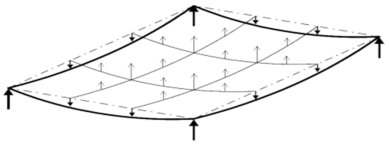
Post-tensioned reinforced concrete takes advantage of the excellent tensile behavior of high strength steel combined with concretes high compressive strength.

Thus, by tensioning up the steel tendons, compression forces and internal forces resulting from the profile of the strands are introduced in the structural elements.

As so, post tensioned structural elements final forces will be subject to a combination of external loads and forces of the prestressing action, resulting in an extremely favorable deformation and state of tension.

Advantages on the use of post-tensioning:

- Longer spans of the structures
- Greater slenderness of the structural elements
- Decreased self-weight
- Service and long-term behavior improvement
- Smaller deformations
- Rational use of concrete and high-strength steels

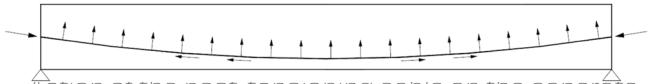


Scheme of the loads equivalent to the post-tension

Post-tensioning systems and techniques:

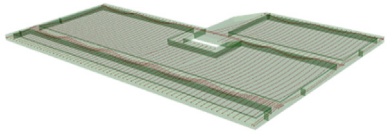
- Steel is tensioned after the concrete achieves the necessary resistance (post-tension);
- The post-tensioning strengths transfer is made at the extremities, by the use of mechanical components (anchorages) and along the length of the strands.

Schematic principle of the post-tensioning action:



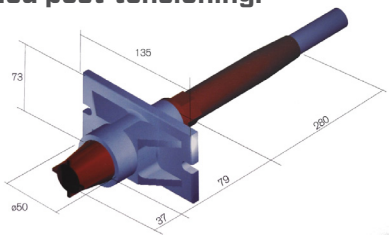
Action of the post-tensioning cable on the concrete

Fercanorte uses in its projects the **Mekano4** post tensioning system.



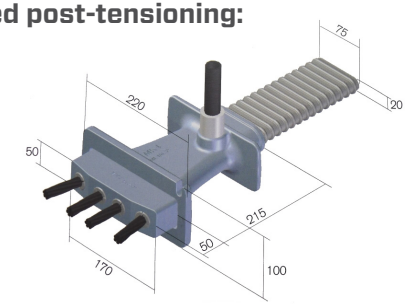
Tridimensional model of the post-tension loads

Unbonded post-tensioning:

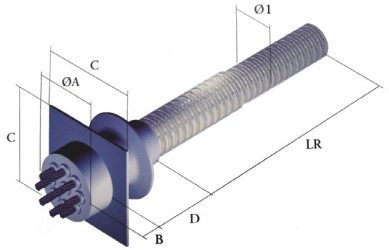


MK4 MUNB 1/0,6" Anchor

Bonded post-tensioning:



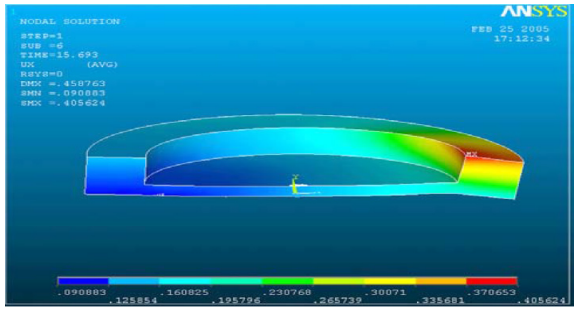
MK4 ML 4/0,6" Anchor



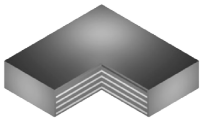
MK4 MSA Anchor

SUPPORT BEARINGS

Fercanorte is the exclusive dealer of the full range of support bearings by Mekano4, whose extensive experience and numerous projects enabled to develop a wide range of support devices for bridges and structures.



ELASTOMERIC BEARINGS



Elastomeric bearings are used in the transmission of vertical loads, allowing small rotations and displacements of the superstructure. Consist of plates of elastomeric material interspersed with steel plates, bonded by vulcanization to the elastomer.

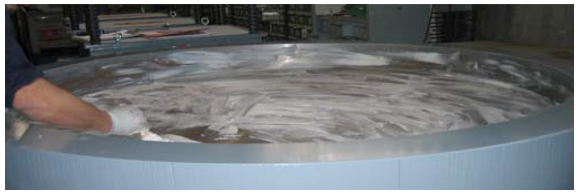


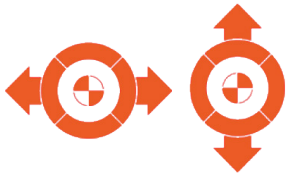


POT BEARINGS



FIXED Fixed pot bearings (PF) transmit vertical and horizontal loads between the deck and the pillars. These supports allow any rotations of the superstructure, but prevent all longitudinal or transverse displacements.





GUIDED Guided pot bearings (PG) transmit horizontal and vertical loads (the latter as long as perpendicular to the support guide) between the deck and the pillars. These supports allow any rotations of the superstructure, but only allow the displacement in one direction (usually longitudinal).





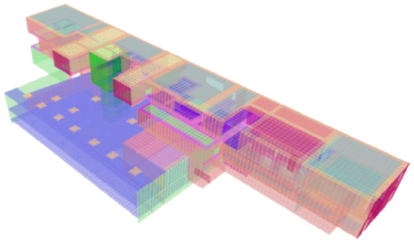
MULTIDIRECTIONAL Multidirectional pot bearings (PM) transmit only vertical loads between the deck and the pillars, allowing rotation and any displacement of the superstructure.

TECHNICAL SUPPORT

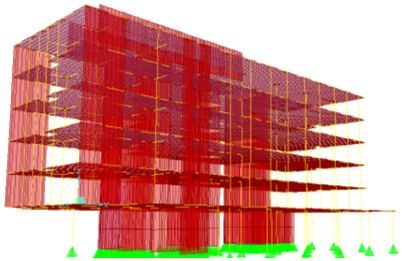
FERCANORTE supplies its technical services to support and follow up of the project, designing, ultimate and serviceability limit state verification and economic analysis of the reinforced concrete or post-tensioned reinforced concrete slabs.

The analysis considers the following:

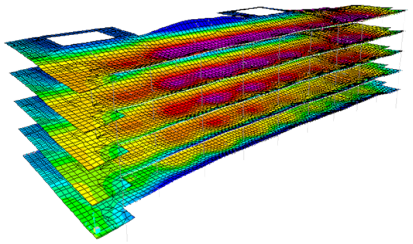
- Finite element structural modeling;
- Concrete cross-section optimization;
- Service state deformation verification
- Evolution of material properties over time (fluence, retraction and relaxation);
- Effects of the internal and external imposed deformations;
- Cost analysis according to market.
- Post-tensioning application projects, loss calculation, verification and optimizations of rebar and PT strands (flexion, shear and punching shear);



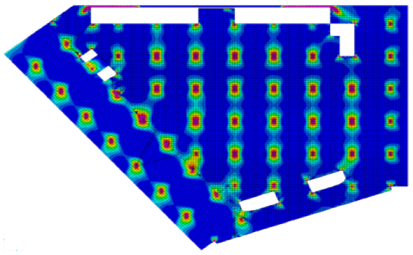
Structural model



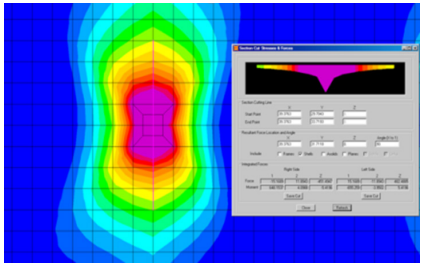
Effects of the internal and external imposed deformations



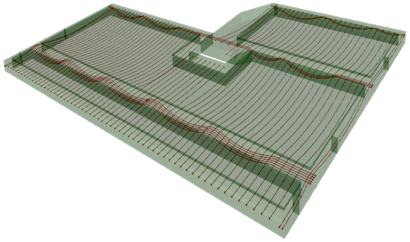
Deformation analysis for infinite time



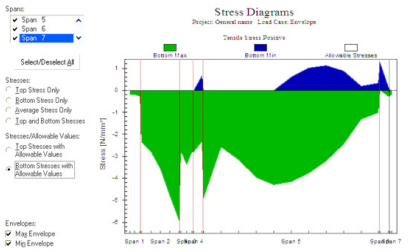
Verification and optimization of rebar and PT strands



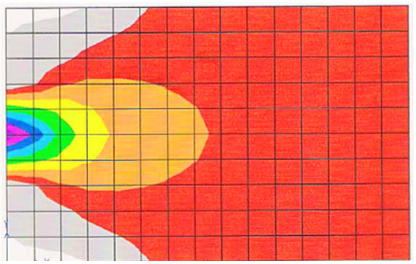
Optimization of rebar



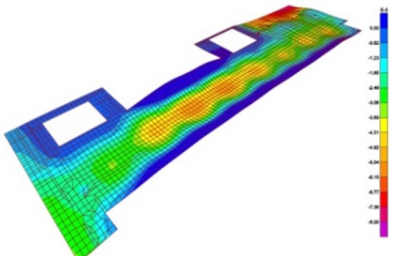
Tridimensional model of the post-tensioning action



Analysis of the stress provoqued by the strands



Analysis of the stress on the anchorage areas



Deformation analysis for infinite time

GROUND FLOORS – VENTILATED SYSTEM

CUPOLEX

The aerated structural flooring system

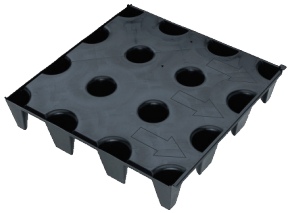
- A recycled plastic domes system.
- A self-bearing modular structure
- A base for floor casting.
- Increases thermic and permeability insulation.
- Allows drainage and aeration on any direction.
- Variable height under floors, suitable to accommodate ducts, pipes and other horizontal infra-structure elements or accessories.



Self-bearing recycled plastic



Waterproofing and insulation; allows drainage and aeration



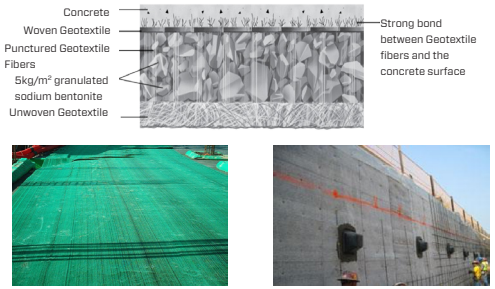


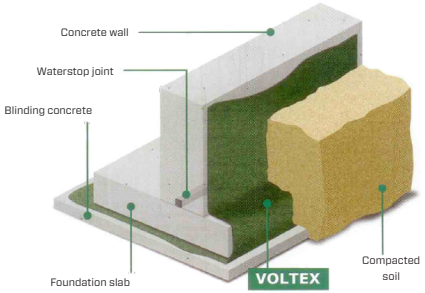


WATERPROOFING

VOLTEX BENTONITIC MEMBRANE

- Highly effective waterproofing composite formed by high strength geotextile and 5 kg per square meter of sodium bentonite.
- Expansion action in contact with water, sealing small cracks in concrete which usually constitute uncontrollable situations.
- Strong mechanical bond with the concrete by the adhesion of the fibers to the surface of the concrete during casting.





WATERSTOP EXPANSION JOINTS

Sodium bentonite flexible strips which expand in contact with water, providing an active insulation of concrete joints.

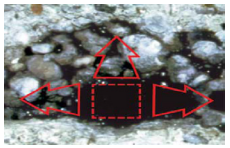
Waterstop joint advantages:

- Weld free easy instalation
- Fills in any cracks by its expansive action, providing active insulation
- No special parts for crosses and corners needed
- Safe; non-toxic and does not require any special handling
- Flexible
- May be installed on preexisting concrete without the need of cutting slots









CATALOG

1 > POST-TENSIONING

1.1 UNBOUNDED SYSTEM

1.2 BOUNDED SYSTEM

2 > WAFFLE SLABS - MOULDS

2.1 FG 900 MOULDS

2.2 FG 800 MOULDS

2.3 FG 600T MOULDS

2.4 FG 600 MOULDS

2.5 REI 120

3 > POST-SHORING - WAFFLE SLABS

3.1 POST-SHORING (RAILINGS AND PROP HEADS)

4 > VOIDED SLABS - NAUTILUS

4.1 “NAUTILUS - FN” BLOCKS

5 > VOIDED SLABS - FUNGIBLOCKS

5.1 FF 80 FERCA BLOCK

5.2 FB 75 FERCA BLOCK

5.3 FB 65 FERCA BLOCK

6 > GROUND FLOORS - VENTILATED SYSTEM

6.1 CUPOLEX

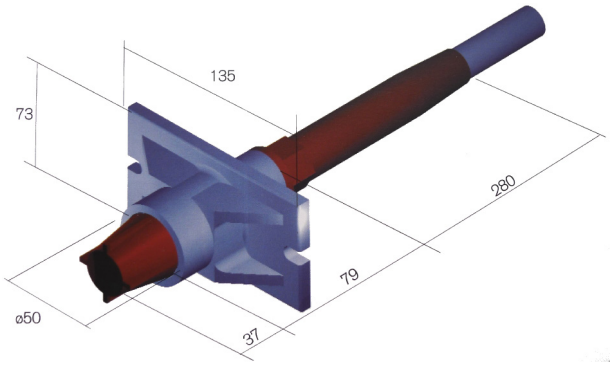
7 > WATERPROOFING

7.1 VOLTEX BENTONITIC MEMBRANE

7.2 WATERSTOP EXPANSIVE JOINTS

7.3 VOLCLAY GRANULAR BENTONITE AND BENTOSEAL

1.1 UNBOUNDED SYSTEM

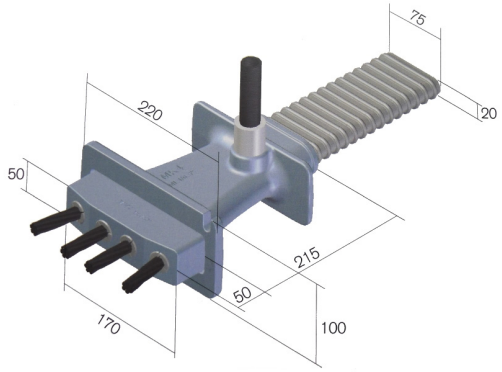


MK4 MUNB 1/0,6” Anchor

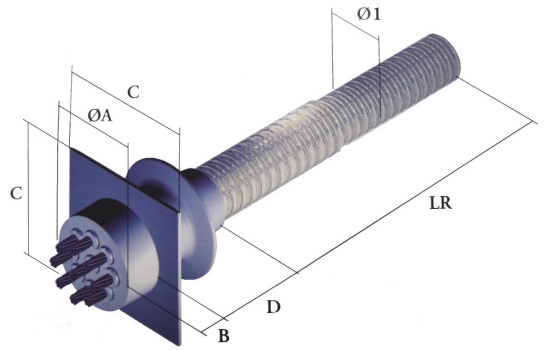
Monostrand	Unit	
Cross Section Area	mm²	140
Nominal Diameter	mm	15,2
Tensile Strength	MPa	1860
Breaking Strength	kN	260
Maximum Tensioning Strength (1)	kN	195
Outer Strand Diameter	mm	18,0
Weight	kg/m	1,25
Elastic Modulus	kN/mm²	200±10

Note (1) - 75% Fpuk

1.2 BOUNDED SYSTEM



MK4 ML4/0,6” Flat Anchor



MK4 MSA Anchor

		Type		ØA	B	C	D	LR	Ø1	Nr. of Strands	Breaking Strength	Max. Tensioning Strength (1)	Weight	Cross Section
				(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		Fpuk (kN)	P0 (kN)	(kg/m)	(mm²)
MSA Anchors	0,6” (15,2 mm)	4-0,6”	T-4	110	50	170	155	600	51/56	2*	521*	391*	2,22*	280*
										3*	782*	586*	3,33*	420*
										4*	1042*	782*	4,44*	560*
		5-0,6”	T-4	110	50	170	155	600	51/56	5	1303	977	5,55	700
		7-0,6”	T-5	129	61	194	150	600	62/67	6	1564	1173	6,66	840
										7	1824	1368	7,77	980
		9-0,6”	T-6	144	60	220	175	900	72/77	8	2085	1564	8,88	1120
										9	2346	1759	9,99	1260
		12-0,6”	T-7	165	72	254	200	900	85/90	10	2607	1955	11,10	1400
										11	2867	2150	12,21	1540
										12	3128	2346	13,32	1680

*** Values also valid for ML4/0,6” flat anchors**

Note (1) - 75% Fpuk

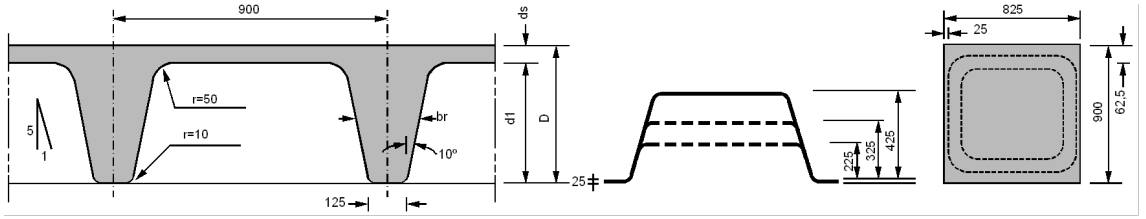
2.1 FG 900 MOULDS

"FG 900" moulds are used on the construction of waffle slabs with bidirectional orthogonal ribs, also called fungiform slabs, producing modules with 900 mm distance between the ribs axis.
There are three different types of "FG 900" moulds, with heights of 225 mm, 325 mm and 425 mm. They were designed with two narrower edges so that they can be removed three days after the concrete casting, keeping the vertical support structure.
They are internally reinforced, guaranteeing very small deformations. Its low weight allows an easy handling on site.







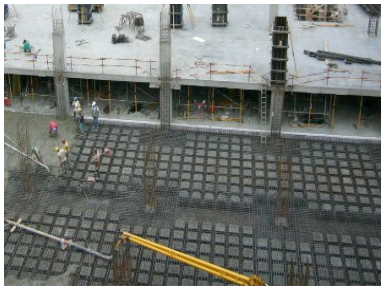


Mould Height	Top Layer Thickness	Total Height	Average Rib Width	Cross Section Area	Distance to G.C.		Inertia (per rib)	Flexion Module (per rib)		Void Volume		Self-Weight	Concrete Volume
					Upper Face	Bottom Face							
mm	mm	mm	mm	cm²	mm	mm	cm⁴/rib	cm³/rib	cm³/rib	m³/mould	m³/m²	KN/m²	m³/m²
225	50	275	172	816	83	192	49561	5971	2581	0,113	0,139	3,45	0,136
	75	300	176	1040	87	213	65670	7548	3083			4,05	0,161
	100	325	180	1266	95	230	84158	8858	3659			4,65	0,186
325	50	375	192	1043	122	253	125718	10304	4969	0,156	0,192	4,60	0,183
	75	400	197	1268	123	277	159245	12947	5749			5,20	0,208
	100	425	203	1493	128	297	194449	15191	6547			5,85	0,233
425	50	475	207	1310	165	310	255029	15456	8226	0,197	0,242	5,85	0,233
	75	500	212	1536	163	337	314390	19347	9315			6,45	0,258
	100	525	217	1761	165	360	374573	22701	10450			7,10	0,283
d1	ds	D	br	A	rs	ri	I	Ws	Wi	Vv		25 KN/m³ Concrete	

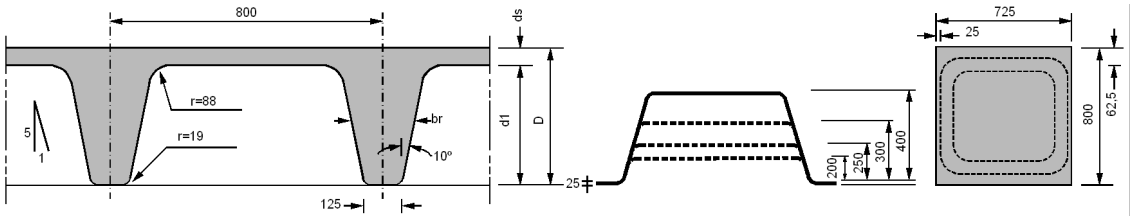
2.2 FG 800 MOULDS

"FG 800" moulds are used on the construction of waffle slabs with bidirectional orthogonal ribs, also called fungiform slabs, producing modules with 800 mm distance between the ribs axis.
There are four different types of "FG 800" moulds, with heights of 200 mm, 250 mm, 300 mm and 400 mm.
They were designed with two narrower edges so that they can be removed three days after the concrete casting, keeping the vertical support structure.
They are internally reinforced, guaranteeing very small deformations. Its low weight allows an easy handling on site.







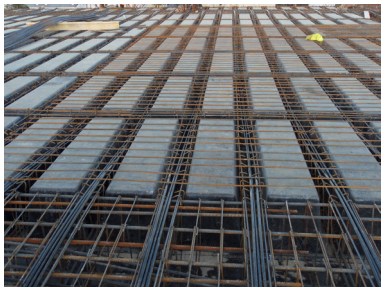


Mould Height	Top Layer Thickness	Total Height	Average Rib Width	Cross Section Area	Distance to G.C.		Inertia (per rib)	Flexion Module (per rib)		Void Volume		Self-Weight	Concrete Volume
					Upper Face	Bottom Face							
mm	mm	mm	mm	cm²	mm	mm	cm⁴/rib	cm³/rib	cm³/rib	m³/mould	m³/m²	KN/m²	m³/m²
200	50	250	164	710	76	174	35092	4617	2017	0,080	0,125	3,15	0,125
	75	275	169	910	82	193	47499	5793	2461			3,75	0,150
	100	300	173	1110	90	210	62176	6908	2961			4,40	0,175
250	50	300	173	810	95	205	60694	6389	2961	0,095	0,148	3,80	0,152
	75	325	177	1010	99	226	79426	8023	3514			4,45	0,177
	100	350	182	1210	106	244	100258	9458	4109			5,05	0,202
300	50	350	182	918	115	235	96048	8352	4087	0,115	0,179	4,30	0,171
	75	375	186	1118	117	258	122897	10504	4763			4,90	0,196
	100	400	190	1318	123	277	151574	12323	5472			5,55	0,221
400	50	450	200	1162	156	294	203062	13017	6907	0,145	0,226	5,60	0,224
	75	475	204	1362	157	318	251824	16040	7919			6,25	0,249
	100	500	208	1562	160	340	301779	18861	8876			6,85	0,274
d1	ds	D	br	A	rs	ri	I	Ws	Wi	Vv		25 KN/m³ Concrete	

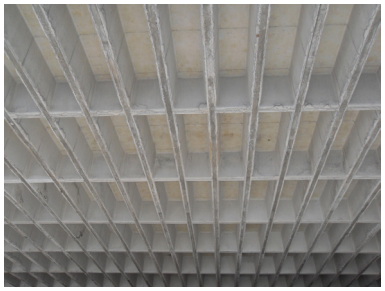
2.3 FG 600T MOULDS

Designed for predominantly single direction waffle slabs, with main rib spacing of 600 mm and variable secondary rib spacing, producing ribs b=125 mm wide.
Two tip modules (A) may be combined with a variable amount of middle modules (B), originating different lengths, like 1200 mm, 1910 mm, etc.

Moulds come with 325 mm and 425 mm height.







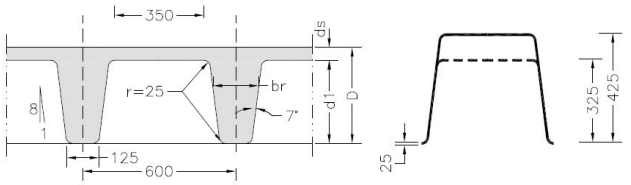
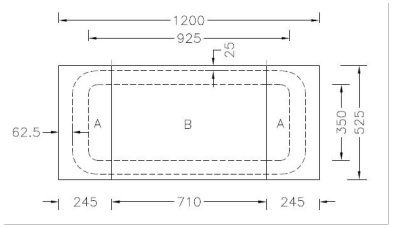
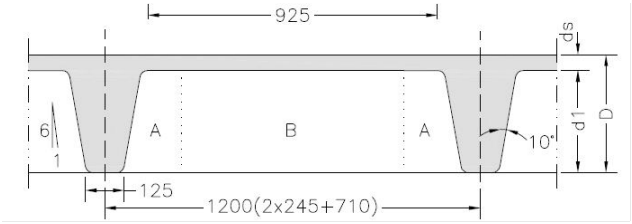


Table 1 - Geometry and Technical Details

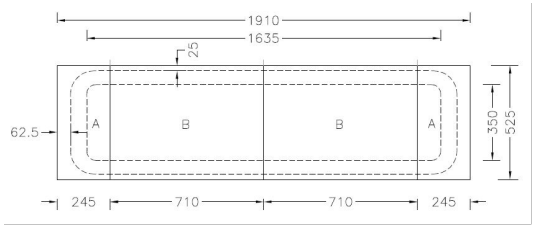
Mould Height	Top Layer Thickness	Total Height	Average Rib Width	Rib Cross-Section Area	Distance to G. C.		Inertia (per rib)	Flexion Module (per rib)	
					Upper Face	Inferior Face			
mm	mm	mm	mm	cm²	mm	mm	cm⁴/rib	cm³/rib	cm³/rib
325	50	375	171	838	136	239	104560	7688	4375
	75	400	175	988	138	262	132740	9619	5066
	100	425	178	1138	143	282	162540	11366	5764
425	50	475	184	1057	179	296	210410	11755	7108
	75	500	187	1207	180	320	258750	14375	8086
	100	525	190	1357	184	341	308450	16764	9045
d1	ds	D	br	A	vs	vi	I	Ws	Wi

FG 600T - 0,60 x 1,20 m (2A+1B) RIB MESH





FG 600T - 0,60 x 1,91 m (2A+2B) RIB MESH



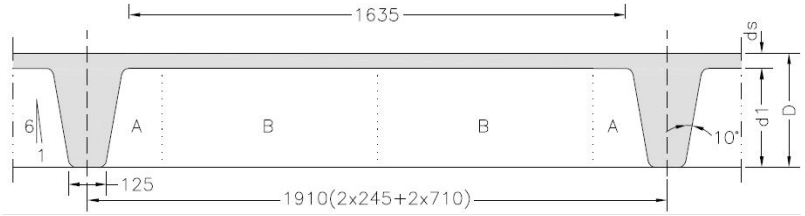


Table 2 - Volumes and Self Weights

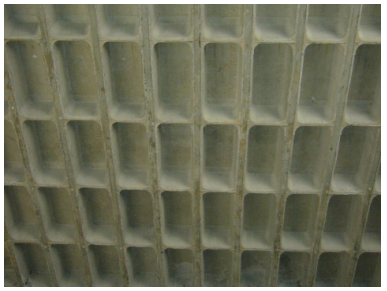
Mould Height	Top Layer Thickness	Total Height	0,60 x 1,20 m Rib Mesh				0,60 x 1,91 m Rib Mesh			
			Void Volume		Self Weight	Concrete Volume	Void Volume		Self Weight	Concrete Volume
mm	mm	mm	m³/mould	m³/m²	KN/m²	m³/m²	m³/mould	m³/m²	KN/m²	m³/m²
325	50	375	0,143	0,199	4,41	0,176	0,242	0,211	4,10	0,164
	75	400			5,03	0,201			4,72	0,189
	100	425			5,66	0,226			5,35	0,214
425	50	475	0,179	0,249	5,66	0,226	0,306	0,267	5,20	0,208
	75	500			6,28	0,251			5,82	0,233
	100	525			6,91	0,276			6,45	0,258
d1	ds	D	Vv		25 KN/m³ Concrete		Vv		25 KN/m³ Concrete	

2.4 FG 600 MOULDS

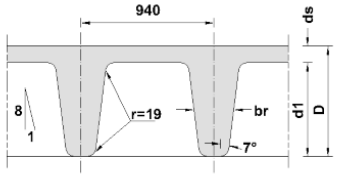
Designed for predominantly single direction waffle slabs, with main rib spacing of 600 mm and secondary rib spacing of 1.200 mm, producing ribs b=125 mm wide.
Frequently used with metallic support structures, they were designed with narrow edges on two opposite sides so that the mould can be removed, keeping the vertical support structure.
Moulds have their interior ribbed so that they form an elongated monolithic unit, assuring very small deformation.

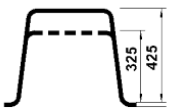
Moulds come with 325 mm and 425 mm height.

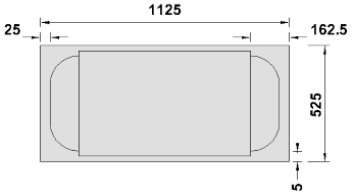










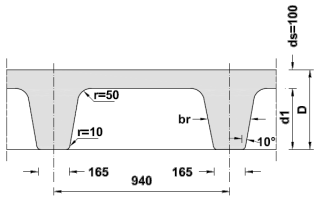


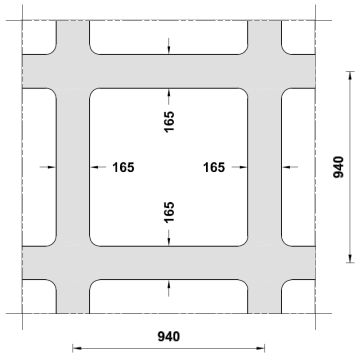
Mould Height	Top Layer Thickness	Total Height	Average Rib Width	Cross Section	Distance to G.C.		Inertia (per rib)	Flexion Module (per rib)		Void Volume		Rib Mesh 0.60m x 1.20m	
					Upper Face	Bottom Face						Self-Weight	Concrete Volume
mm	mm	mm	mm	cm²	mm	mm	cm⁴/rib	cm³/rib	cm³/rib	m³/mould	m³/m²	KN/m²	m³/m²
325	50	375	172	838	137	238	108773	7945	4568	0,151	0,210	4,13	0,165
	75	400	175	988	139	261	135256	9716	5186			4,75	0,190
	100	425	178	1138	144	281	164000	11373	5840			5,38	0,215
425	50	475	184	1057	180	195	200453	11136	6795	0,190	0,264	5,28	0,211
	75	500	188	1207	181	319	249191	13759	7814			5,90	0,236
	100	525	191	1357	185	340	299250	16201	8793			6,53	0,261
d1	ds	D	br	A	rs	ri	I	Ws	Wi	Vv		25 KN/m³ Concrete	

2.5 REI 120 FIRE RESISTANCE

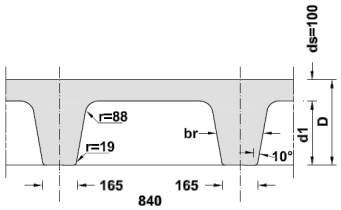
- FG 940 e FG 840 Moulds
- Increased rib width / top layer thickness

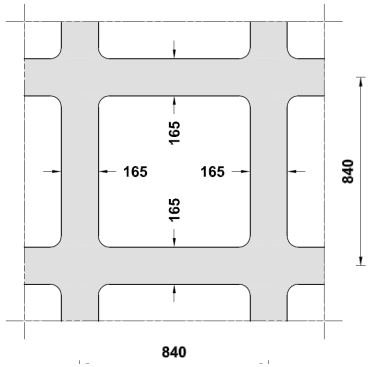
FG 940 Modulation





FG 840 Modulation

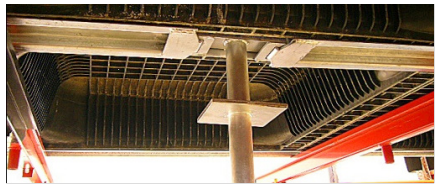




Mould Width	Mould Height	Top Layer Thickness	Total Height	Average Rib Width (excluding top layer)	Cross Section Area	Distance to G. C.		Inertia (per rib)	Flexion Module (per rib)		Void Volume		Self Weight	Concrete Volume
						Upper Face	Lower Face							
mm	mm	mm	mm	mm	cm²	mm	mm	cm⁴/rib	cm³/rib	cm³/rib.	m³/mould	m³/m²	KN/m²	m³/m²
840	200	100	300	200	1261	97	203	76267	7863	3757	0,080	0,113	4,666	0,187
	250	100	350	209	1383	114	236	122327	10730	5183	0,095	0,135	5,384	0,215
	300	100	400	218	1514	132	268	184186	13953	6873	0,115	0,163	5,925	0,237
	400	100	500	236	1803	171	329	363478	21256	11048	0,145	0,205	7,363	0,295
940	225	100	325	205	1407	101	224	101368	10036	4525	0,113	0,128	4,928	0,197
	325	100	425	222	1669	136	289	230865	16975	7988	0,156	0,177	6,211	0,248
	425	100	525	240	1966	175	350	438924	25081	12541	0,197	0,223	7,551	0,302
	d1	ds	D	br	A	rs	ri	I	Ws	Wi	Vv		25 KN/m³ Concrete	

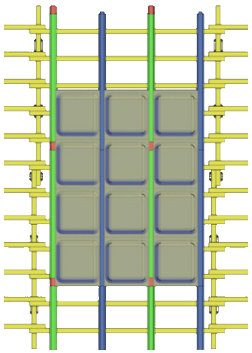
3.1 POST-SHORING – RAILINGS AND PROP HEADS

Complementary formwork and shoring components specially designed for waffle slabs.
This system allows main props, main and secondary beams, rails and moulds to be removed three days after casting.
The slabs keep shored by secondary props, located only under the prop heads (1,80m x 2,50m or 1,60m x 2,50m prop array).

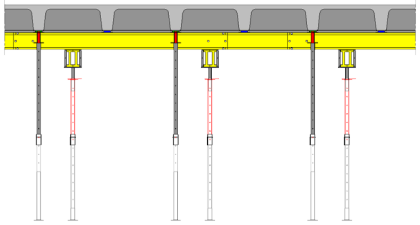




Plant



Cut View
1st Stage – Slab Preparation
Shoring and Post-Shoring



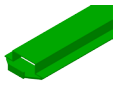
Post-Shoring elements

Rail 2,50 m



Rail 2,35 m

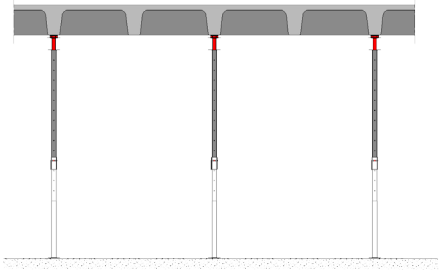




Prop Head



2nd Stage – 3 days after casting
Post-Shoring



Axial load on post-shoring props in waffle slabs:

Mould mesh: 0,80m x 0,80m (FG8M) - [prop array = 1,60m x 2,50m]

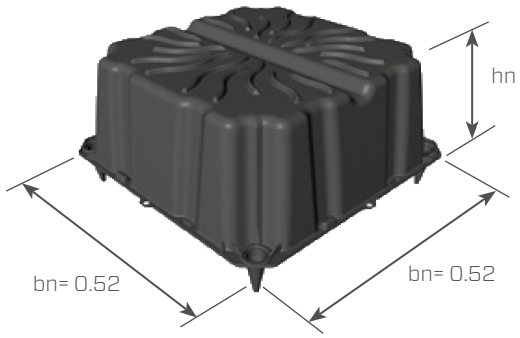
Mould Type	Slab Total Thickness (Ht)	Mould Height (Hm)	Concrete Top Layer (Lc)	Self Weight/m²	Prop Load (post-shoring)
FG8M200	0,250	0,200	0,050	3,15	12,60
	0,275		0,075	3,75	15,00
	0,300		0,100	4,40	17,60
FG8M250	0,300	0,250	0,050	3,80	15,20
	0,325		0,075	4,45	17,80
	0,350		0,100	5,05	20,20
FG8M300	0,350	0,300	0,050	4,30	17,20
	0,375		0,075	4,90	19,60
	0,400		0,100	5,55	22,20
FG8M400	0,450	0,400	0,050	5,60	22,40
	0,475		0,075	6,25	25,00
	0,500		0,100	6,85	27,40
	(m)	(m)	(m)	(KN/m²)	(KN)

Mould mesh: 0,90m x 0,90m (FG9M) - [prop array = 1,80m x 2,50m]

Mould Type	Slab Total Thickness (Ht)	Mould Height (Hm)	Concrete Top Layer (Lc)	Self Weight/m²	Prop Load (post-shoring)
FG9M225	0,275	0,225	0,050	3,45	15,53
	0,300		0,075	4,05	18,23
	0,325		0,100	4,65	20,93
FG9M325	0,375	0,325	0,050	4,60	20,70
	0,400		0,075	5,20	23,40
	0,425		0,100	5,85	26,33
FG9M425	0,475	0,425	0,050	5,85	26,33
	0,500		0,075	6,45	29,03
	0,525		0,100	7,10	31,95
	(m)	(m)	(m)	(KN/m²)	(KN)

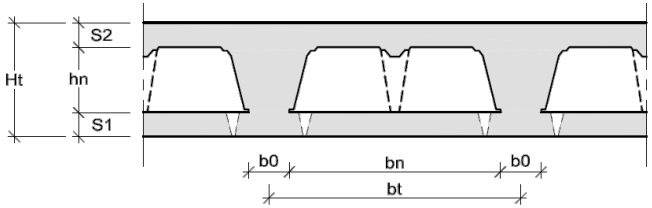
4.1 “NAUTILUS-FN” SINGLE MODULE

- Voided Slabs.
- Flat ceilings.



	Nautilus Model [hn] cm	Feet Height [s1] cm	Rib Width [b0] cm
Single Module	H 10	5	12
	H 13	6	14
	H 16	7	16
	H 20	8	18
	H 24	9	20
	H 28	10	

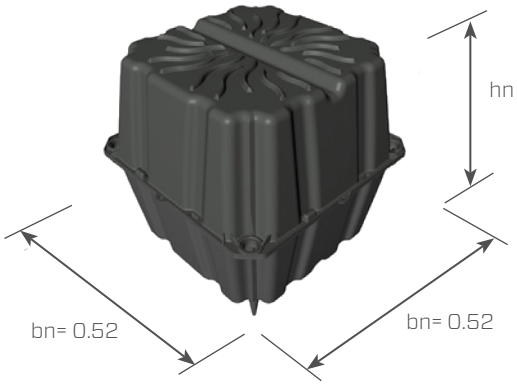




Total Thickness [Ht]	Bottom Layer [s1]	“Nautilus” Height [hn]	Top Layer [s2]	Rib Width [b0]	“Nautilus” Width [bn]	Rib Axis Distance [bt]	Inertia (per rib) [I]	Void Volume [Vv]		Concrete Volume [Vb]	Self Weight [p.p.]
cm	cm	cm	cm	cm	cm	cm	cm⁴/rib	m³/un.	m³/m²	m³/m²	kN/m²
Ht = 20	5	10	5	12	52	64	38622	0,024	0,058	0,142	3,55
Ht = 23	5	13	5	12	52	64	56467	0,028	0,068	0,162	4,04
Ht = 26	5	16	5	12	52	64	78043	0,032	0,078	0,182	4,55
Ht = 30	5	20	5	12	52	64	113451	0,039	0,095	0,205	5,12
Ht = 34	5	24	5	12	52	64	157116	0,046	0,112	0,228	5,69
Ht = 38	5	28	5	12	52	64	209820	0,051	0,125	0,255	6,39

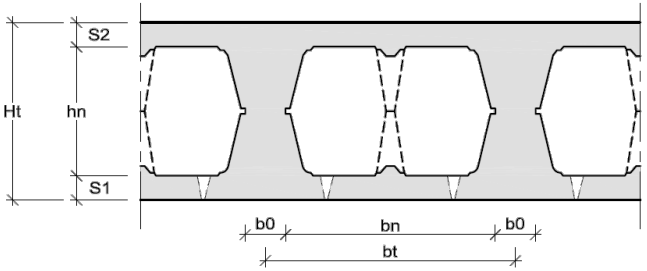
4.2 “NAUTILUS-FN” DOUBLE MODULE

- Voided Slabs.
- Flat ceilings.



	Nautilus Model [hn] cm	Feet Height [s1] cm	Rib Width [b0] cm
Double Module	H 20	5	12
	H 23	6	14
	H 26	7	16
	H 29	8	18
	H 32	9	20
	H 33	10	
	H 36		
	H 37		
	H 40		

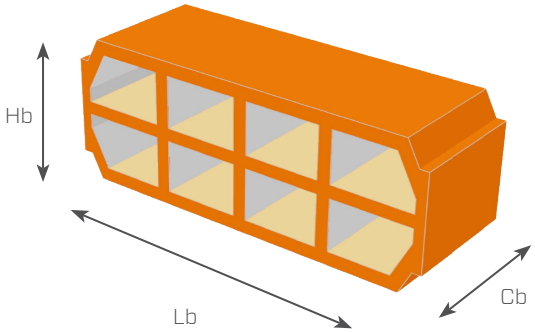


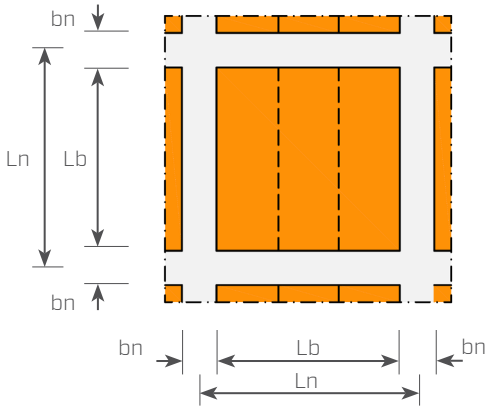


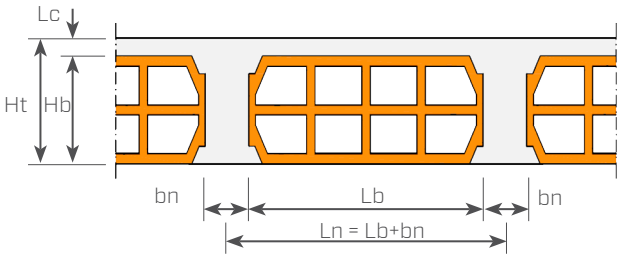
Total Thickness [Ht]	Bottom Layer [s1]	“Nautilus” Height [hn]	Top Layer [s2]	Rib Width [b0]	“Nautilus” Width [bn]	Rib Axis Distance [bt]	Inertia (per rib) [I]	Void Volume [Vv]		Concrete Volume [Vb]	Self Weight [p.p.]
cm	cm	cm	cm	cm	cm	cm	cm⁴/nerv.	m³/un.	m³/m²	m³/m²	kN/m²
Ht = 32	6	20	6	12	52	64	145356	0,048	0,117	0,203	5,07
Ht = 35	6	23	6	12	52	64	183787	0,052	0,127	0,223	5,58
Ht = 38	6	26	6	12	52	64	227696	0,057	0,139	0,241	6,02
Ht = 41	6	29	6	12	52	64	277452	0,060	0,146	0,264	6,59
Ht = 44	6	32	6	12	52	64	333395	0,064	0,156	0,284	7,09
Ht = 45	6	33	6	12	52	64	353475	0,067	0,164	0,286	7,16
Ht = 48	6	36	6	12	52	64	418133	0,070	0,171	0,309	7,73
Ht = 49	6	37	6	12	52	64	441052	0,071	0,173	0,317	7,92
Ht = 52	6	40	6	12	52	64	515393	0,078	0,190	0,330	8,24
Ht = 53	6	41	6	12	52	64	497963	0,079	0,193	0,337	8,43
Ht = 56	6	44	6	12	52	64	576062	0,084	0,205	0,355	8,87
Ht = 60	6	48	6	12	52	64	639574	0,092	0,225	0,375	9,38
Ht = 64	6	52	6	12	52	64	764442	0,097	0,237	0,403	10,08
Ht = 68	6	56	6	12	52	64	1048163	0,102	0,249	0,431	10,77

5. FUNGIBLOCKS

- Lightweight concrete Ferca Blocks
- Bidirectional or unidirectional ribbed slabs
- Beamless, plane, inferior surface (plane ceilings)
- Need for inferior finishing of the slab
- Good acoustic, fire resistance and thermic characteristics







5.1 FERCA BLOCK FF80

BLOCK PROPERTIES:

BLOCK	DIMENTIONS (cm)			Unitary Weight
	Lb cm	Cb cm	Hb cm	Kg
FF 80/20	80,0	26,6	20,0	19,0
FF 80/25	80,0	26,6	25,0	23,0
FF 80/30	80,0	26,6	30,0	24,0
FF 80/35	80,0	26,6	35,0	25,0
FF 80/40	80,0	26,6	40,0	26,0

5.2 FERCA BLOCK Fb75

BLOCK PROPERTIES:

BLOCK	DIMENTIONS (cm)			Unitary Weight
	Lb cm	Cb cm	Hb cm	Kg
Fb 75/20	75,0	25,0	20,0	20,0
Fb 75/25	75,0	25,0	25,0	22,0
Fb 75/30	75,0	25,0	30,0	24,0
Fb 75/34	75,0	25,0	34,0	27,0
Fb 75/40	75,0	25,0	40,0	31,0

5.3 FERCA BLOCK Fb65

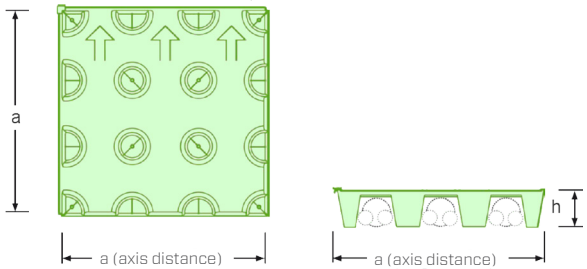
BLOCK PROPERTIES:

BLOCK	DIMENTIONS (cm)			Unitary Weight
	Lb cm	Cb cm	Hb cm	Kg
Fb 65/20	65,0	21,6	20,0	14,0
Fb 65/25	65,0	21,6	25,0	17,0
Fb 65/30	65,0	21,6	30,0	18,0
Fb 65/34	65,0	21,6	34,0	20,0
Fb 65/40	65,0	21,6	40,0	28,0

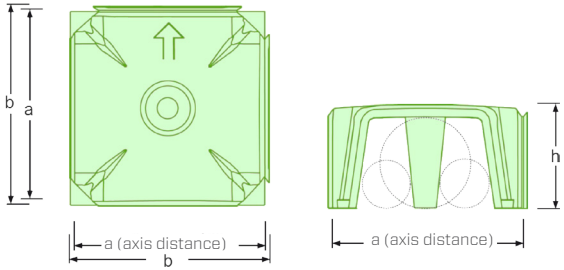
For additional information please contact Fercanorte services.

6.1 CUPOLEX

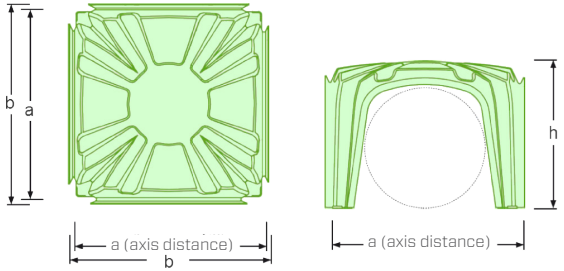
CUPOLEX WINDY h5, h10



CUPOLEX h9.5, h13.5, h20, h26, h30, h35, h40, h45, h50



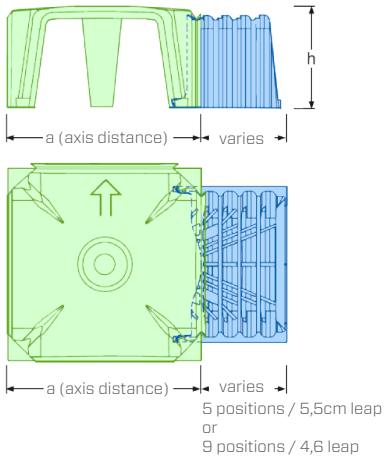
CUPOLEX h55, h60, h65, h70



Name	a cm	b cm	h cm	Concrete consumption (to the dome top) m³/m²	Pipe Passing uni.Ømm
Windi h5	56,0	56,0	5,0	0,008	7ø30
Windi h10	56,0	56,0	10,0	0,011	3ø75 or 6ø50
Cupolex h9,5	56,0	57,1	9,5	0,014	4ø70
Cupolex h13,5	56,0	58,0	13,5	0,030	3ø60 or 1ø90*
Cupolex h20	56,0	58,0	20,0	0,040	2ø100 or 1ø150*
Cupolex h26	56,0	58,0	26,0	0,035	2ø145 or 1ø190*
Cupolex h30	56,0	57,2	30,0	0.042	2ø145 or 1ø260*
Cupolex h35	56,0	58,0	35,0	0,045	2ø150 or 1ø300*
Cupolex h40	56,0	58,0	40,0	0,060	2ø140 or 1ø250*
Cupolex h45	56,0	58,0	45,0	0,065	2ø150 or 1ø300*
Cupolex h50	56,0	57,0	50,0	0,065	2ø150 or 1ø300*
Cupolex h55	71,0	74,5	55,0	0,069	1ø450
Cupolex h60	71,0	74,5	60,0	0,070	1ø460
Cupolex h65	71,0	74,5	65,0	0,071	1ø470
Cupolex h70	71,0	74,5	70,0	0,073	1ø480

Note: * cutting central cone

BETONSTOP h20, h26, h30, h35, h40, h45, h50, h55, h60, h65, h70



5 positions / 5,5cm leap
or
9 positions / 4,6 leap

Name	Nr. of positions	Leap cm
Betonstop h20	5	5,5
Betonstop h26	5	5,5
Betonstop h30	5	5,5
Betonstop h35	5	5,5
Betonstop h40	5	5,5
Betonstop h45	5	5,5
Betonstop h50	5	5,5
Betonstop h55	9*	4,6
Betonstop h60	9*	4,6
Betonstop h65	9*	4,6
Betonstop h70	9*	4,6

Note: * modules may be cut in half

Additional information at fercanorte.com.pt

7.1 VOLTEX SODIUM BENTONITE MEMBRANE

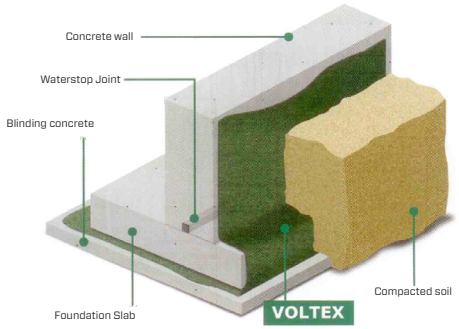
Voltex is used on horizontal and vertical concrete surface waterproofing. It presents itself in three different varieties:

VOLTEX - sodium bentonite geosynthetic membrane, specially formulated to concrete structures waterproofing .

VOLTEX DS - improved geosynthetic membrane. To one of the conventional Voltex faces a high density polyethylene layer was added, dramatically reducing the material permeability. Recommended for when a double barrier against water entry is required.

VOLTEX CRDS - a special Voltex DS formula for high level of contamination and high electrical conductivity aggressive waters.





Property	Test Method	Reference Value
Hidrostactic head resistance	ASTM D 5385 mod.	70 m
Permeabilty	ASTM D 5084	1 x 10-9 cm/sec.
Traction resistance	ASTM D 4632	422 N
Puncture resistance	ASTM D 4833	445 N
Low temperature flexibility	ASTM D 1970	Unaffected at -32ºC
Adhesion to concrete	ASTM D 903 mod.	2.6 kN/m

Voltex is supplied in 1.1 m x 5.0 m (192.5 m^2) 35 roll pallets and may be produced in custom measures for big dimension special projects, as long as one of the dimensions is of 5.0 m and the other is between 1.1 m and 40.0 m. The product weight depends on the moisture content and may vary between 6 and 7 kg/m^2

7.2 WATERSTOP EXPANSIVE JOINTS

Waterstop expansive joints are meant to be used on the insulation of concrete casting unions, being confined between the existing concrete piece and the new piece to be casted. They present themselves in three forms:

WATERSTOP RX-101 - 20 mm x 25 mm rectangular cross-section. Supplied in 30 m boxes.

WATERSTOP RX-102 - 20 mm x 10 mm semi-circular cross-section. Supplied in 61 m boxes.

WATERSTOP XP – for insulation of contaminated waters. 10 mm x 15 mm rectangular cross-section. Supplied in 48 m boxes.

RX101 and RX102, joints are attached to concrete using **Revofix**. metallic mesh. XP joint is applied either using **Revofix** metallic mesh or **Cetseal** sealent/adhesive.

Property	Test Method	Result
Specific Weight at 250C	ASTM D-71	1,57
Resoftning point	ASTM D-30	N.A.
Penetration	ASTM D-217 150 GLT 300 GLT	 58 85
Ignition point	ASTM D-93-97	365
Aging	Mechanical oven 4 hours at 1000C	99% of solids conserved
Fluence resistance	2 cm joint exposed to580C during 7 days	Non fluid
Shelf life		Undefined
Aplication temperature		- 50C a + 520C
Service remperature		- 400C a + 1000C
Hidrostactic head resistance	Pressure test	70,4 m

7.3 GRANULAR BENTONITE AND BENTOSEAL

To seal critical points (corners, holes, joints) **granular bentonite** may be used, either on its strand or water mixed paste forms, as well as the readymade bentonite and expansive polymer mixture, **Bentoseal**, specially indicated to be applyed on vertical surfaces and highly electrically conductive waters.

PORTFOLIO

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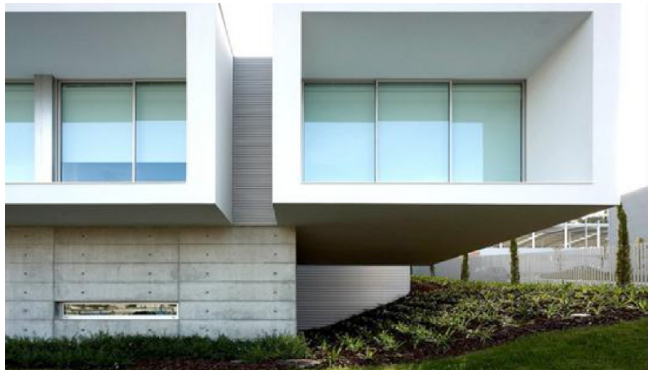
Gaiart's Plaza Centrum
V. N. Gaia







Europa - Ar Lindo
Celeirós, Braga






Mr. Nuno Afonso House
Monção



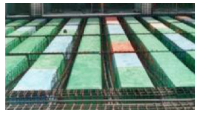



Agostinho Neto Library
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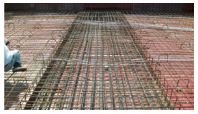



Dolce Vita Shopping Center
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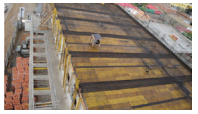
Agro-Alimentar Tec. School
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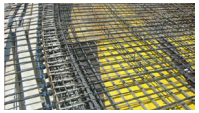






Manuel Firmino Market
Aveiro







Fernando Pessoa Universitary Hospital
Gondomar







N. Sra. Conceição Church
Guimarães







EB2/3 Frei João School
Vila do Conde







Boavista Private Hospital
Porto



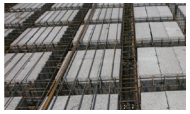




EB2/3 Gondomar School
Gondomar







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