

u-bootbeton[®]

www.daliform.com



**Disposable formwork
for lightened structures in
reinforced concrete cast on site**



dali**form**
GROUP
Building Innovation © Creatori dell'Iglù[®]

BAYGAR

KEY:



Formwork



Utility passage



Foundations



Certifications

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u-bootbeton®

U-Boot Beton® is a recycled polypropylene formwork that was designed to create lightened slabs and rafts. The use of **U-Boot Beton®** formwork makes it possible to create mushroom pillars, with the possibility to have the mushroom in the thickness of the slab.

Thanks to the conic elevator foot, immersing the **U-Boot Beton®** formworks in the concrete casting will create a gridwork of mutually perpendicular beams closed from the bottom and the top by a flat plate that is created with a single casting; this results in considerable reduction in the use of concrete and steel.

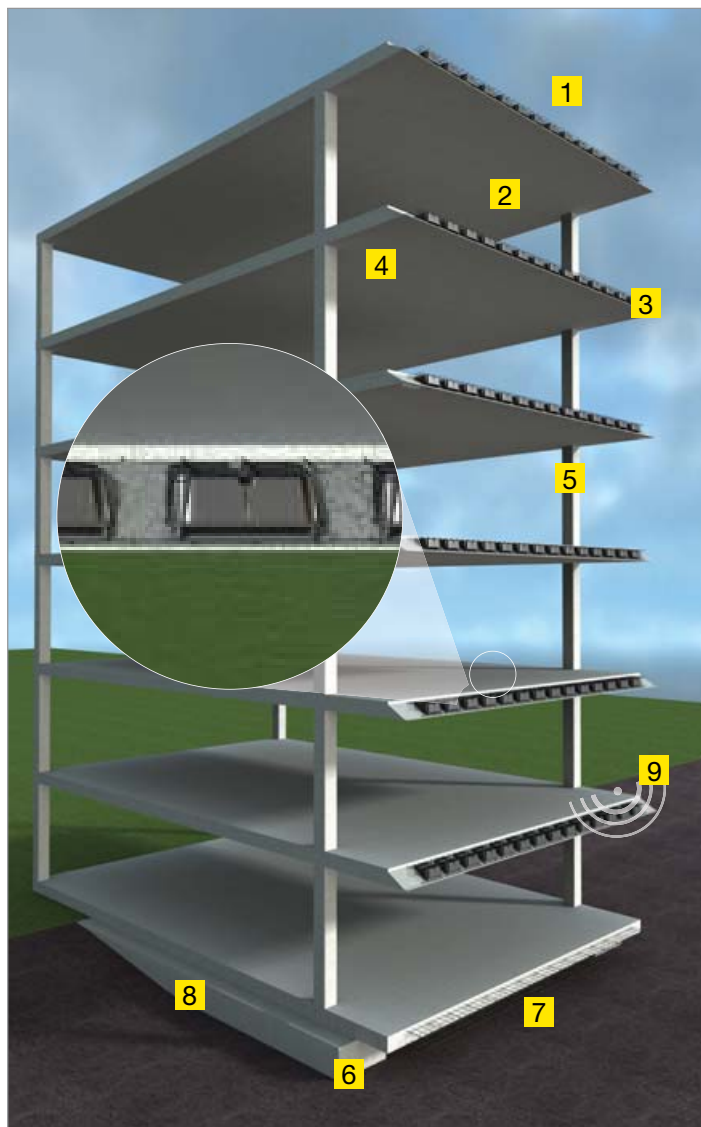
U-Boot Beton® is used to create slabs with large span or that are able to support large loads without beams.

Light and quick and easy to position, thanks to their modularity the designer can vary the geometric parameters as needed to adapt to all situations with great architectural freedom.

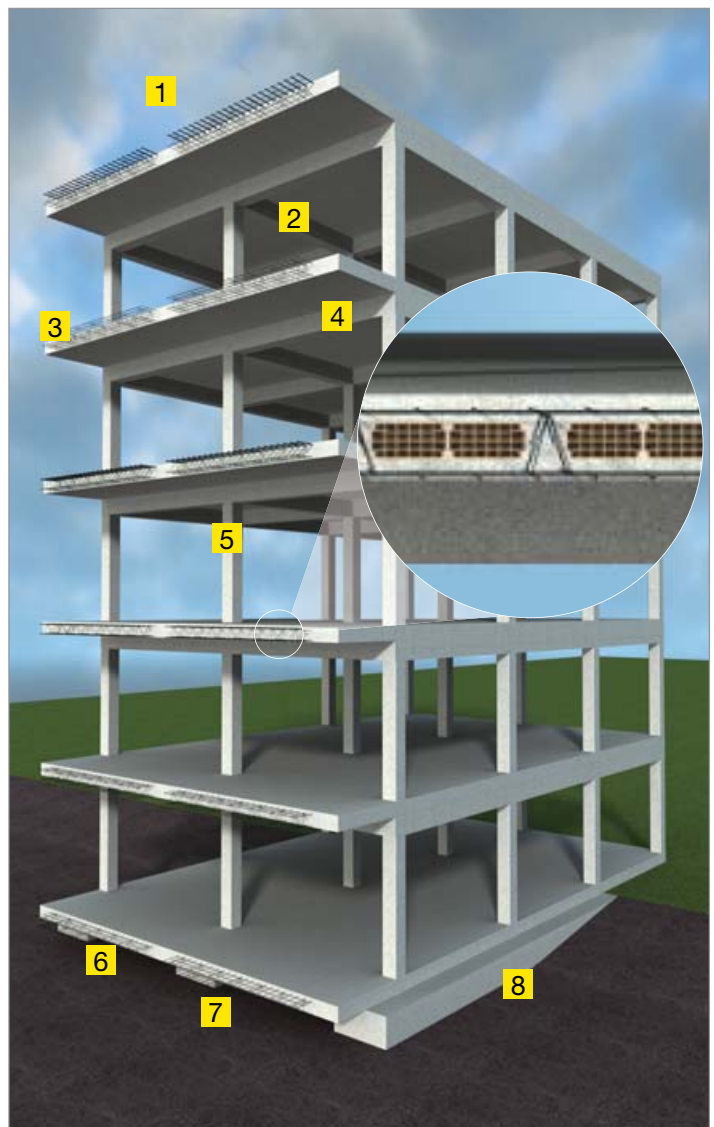


Advantages

System optimised with U-Boot Beton[®]



Traditional one way slab



1 INCREASED NUMBER OF FLOORS

Possibility to gain floors at the same building height (towers) and building volume.

2 LARGE SPAN AND GREAT ARCHITECTURAL FREEDOM

Larger spaces.

3 REDUCED SLAB THICKNESS

Thinner slabs but with equal loads and clearances, or bigger clearances with an equal thickness.

4 NO BEAMS BETWEEN PILLARS

Flat soffit for greater flexibility when installing systems.

5 REDUCTION IN THE NUMBER OF PILLARS

Facilitated use reallocation.

5 OPTIMISATION OF THE SECTION OF PILLARS

Wider bays.

6 REDUCTION IN THE OVERALL LOAD OF THE STRUCTURE WEIGHING ON THE PILLARS AND THE FOUNDATION

7 REDUCED FOUNDATIONS

Less excavation.

8 LESS DEEP FOUNDATION EXCAVATION

Lower costs for foundation excavations.

9 IMPROVED ACOUSTIC BEHAVIOUR

Less acoustic transmittance.

Real advantages

We are incorrectly led to estimate the advantage of a slab lightened with U-Boot Beton® limiting it to a mere comparison between savings in concrete and the cost of the formwork on the level of the slabs only. In this way however, as the analysis is immediate and intuitive, it does not account for the various economic, practical and operational advantages provided with U-Boot Beton® for the entire structure: less use of iron in the slabs, pillars and foundation up to a total of 15% (also in the case of variants); less concrete is used not only for the slabs but also for the columns and foundations; there are antiseismic advantages connected to reduced building weight; slimmer pillars and foundations, lower costs related to excavation for foundations; the arrangement, also irregularly if needed, of the pillars to reflect the architectural freedom of the structure. Reduction of work and overhead transfer of the formworks; advantages in on-site logistics.

LIGHT - THIN - BIDIRECTIONAL

Reduction of weight up to 40%. Reduced deformations (maximum loss of stiffness- 15%). Reduction of the foundation load. Reduction of columns section or their number.

ECONOMIC

Lower concrete cost with an equal thickness.

Lower steel cost.

Savings in useful height on each level as there are no emerging beams.

Possibility to gain floors at the same building height (towers) and building volume.

Quick and easy to implement.

Also indicated for the top-down technique.

Possibility of large span at equal load or high load bearing capacity at an equal span.

Economical and easy to transport, handle and store, also outdoors.

The soffit has a flat surface that is ready to finish and does not require a false ceiling for aesthetic purposes.

If a false ceiling, is required it can be created faster.

FLEXIBLE

LSpan up to 20 m. No beams between pillars. Reduction in the number of pillars. Can be used together with prefabs. Does not require handling and/or hoisting equipment. Possibility of single direction structures thanks to the bridge accessory.

EARTHQUAKE PROOF

Lower seismic mass. Fewer dimensional limitations for the elements. Double slab, upper and lower.

OPEN SPACES

Larger spaces. Greater architectural freedom. Simplified changes to the purpose of use.

FIRE RESISTANT

Considerable fire resistance certified REI 180 with a concrete cover of only 3.5 cm.

IMPROVED ACOUSTIC BEHAVIOUR

Thanks to the increased stiffness of the lower and upper slabs, acoustic transmittancy is decreased.



Applications



Hospital

U-Boot Beton® is used in all applications that require a structural plate together with the need to use less concrete and therefore for a lighter structure. **U-Boot Beton®** is the ideal solution for creating slabs with a large span and/or great load-bearing capacity: it is particularly suited for structures that require considerable open spaces, such as **executive, commercial and industrial buildings as well as public, civil and residential structures**. It makes it possible to more irregularly distribute the pillars, as beams do not need to be created. In the case of yards that are difficult to access or restructuring work, **U-Boot Beton®**, due to its stackability, modularity, lightness and manoeuvrability, can be used to make horizontal structures without the help of handling and hoisting equipment. With **U-Boot Beton®** also foundation rafters can be created with a larger thickness with a reduced amount of concrete.



Multi-level parking building



School

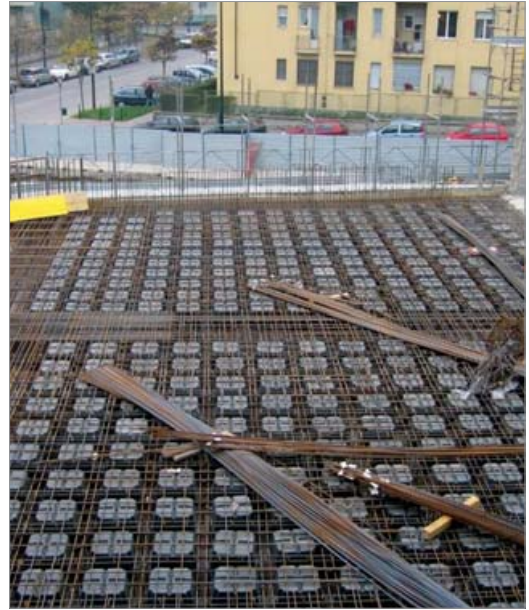


Public building

Photo gallery



Tower building - Arch. Paolo Portoghesi



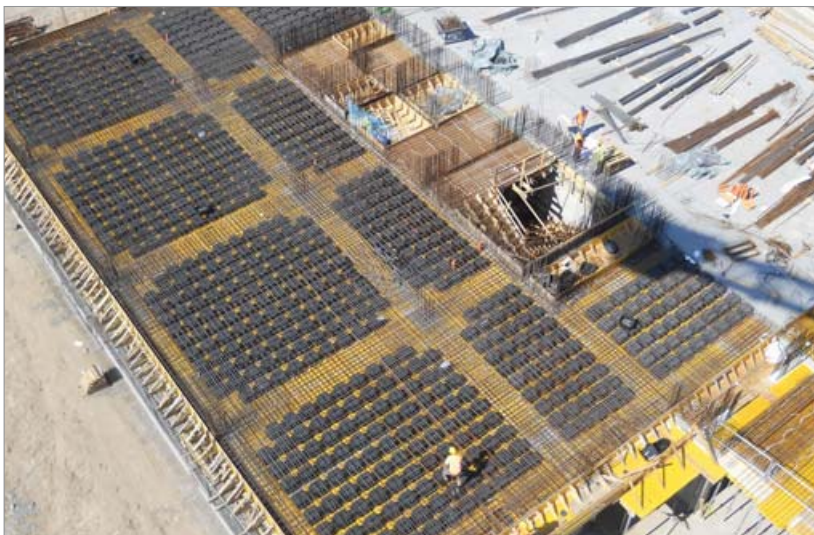
Automobile museum of Turin



Project Vulcano Buono- Arch. Renzo Piano



Hospital Borgo Trento



Building for industrial use



Headquarters of the ITC Lab Kilometro Rosso - Arch. Richard Meier

Formwork	Base	Height H	Feet p	Spacers d	Joist width	Joist centre distance	U-Boot incidence	Concrete saving		Concrete consumption
	cm	cm	cm	cm	cm	cm	pcs/m²	m³/pcs	m³/m²	m³/m²
u - 34*	52 x 52	34	0-5-6-7-8-9-10	0,8	12	64	2,44	0,068	0,166	0,174
					14	66	2,30		0,156	0,184
					16	68	2,16		0,147	0,193
					18	70	2,04		0,139	0,201
					20	72	1,93		0,131	0,209
u - 36*	52 x 52	36	0-5-6-7-8-9-10	0,8	12	64	2,44	0,070	0,171	0,189
					14	66	2,30		0,161	0,199
					16	68	2,16		0,151	0,209
					18	70	2,04		0,143	0,217
					20	72	1,93		0,135	0,225
u - 37*	52 x 52	37	0-5-6-7-8-9-10	0,8	12	64	2,44	0,075	0,183	0,187
					14	66	2,30		0,172	0,198
					16	68	2,16		0,162	0,208
					18	70	2,04		0,153	0,217
					20	72	1,93		0,145	0,225
u - 38*	52 x 52	37	0-5-6-7-8-9-10	0,8	12	64	2,44	0,074	0,181	0,199
					14	66	2,30		0,170	0,210
					16	68	2,16		0,160	0,220
					18	70	2,04		0,151	0,229
					20	72	1,93		0,143	0,237
u - 40*	52 x 52	40	0-5-6-7-8-9-10	0,8	12	64	2,44	0,078	0,190	0,210
					14	66	2,30		0,179	0,221
					16	68	2,16		0,169	0,231
					18	70	2,04		0,159	0,241
					20	72	1,93		0,150	0,250
u - 41*	52 x 52	41	0-5-6-7-8-9-10	0,8	12	64	2,44	0,081	0,198	0,212
					14	66	2,30		0,186	0,224
					16	68	2,16		0,175	0,235
					18	70	2,04		0,165	0,245
					20	72	1,93		0,156	0,254
u - 44*	52 x 52	44	0-5-6-7-8-9-10	0,8	12	64	2,44	0,086	0,210	0,230
					14	66	2,30		0,198	0,242
					16	68	2,16		0,186	0,254
					18	70	2,04		0,175	0,265
					20	72	1,93		0,166	0,274
u - 48*	52 x 52	48	0-5-6-7-8-9-10	0,8	12	64	2,44	0,094	0,229	0,251
					14	66	2,30		0,216	0,264
					16	68	2,16		0,203	0,277
					18	70	2,04		0,192	0,288
					20	72	1,93		0,181	0,299
u - 52*	52 x 52	52	0-5-6-7-8-9-10	0,8	12	64	2,44	0,100	0,244	0,276
					14	66	2,30		0,230	0,290
					16	68	2,16		0,216	0,304
					18	70	2,04		0,204	0,316
					20	72	1,93		0,193	0,327
u - 56*	52 x 52	56	0-5-6-7-8-9-10	0,8	12	64	2,44	0,106	0,259	0,301
					14	66	2,30		0,243	0,317
					16	68	2,16		0,229	0,331
					18	70	2,04		0,216	0,344
					20	72	1,93		0,204	0,356



Project Treviso Maggiore - Arch. Mario Botta

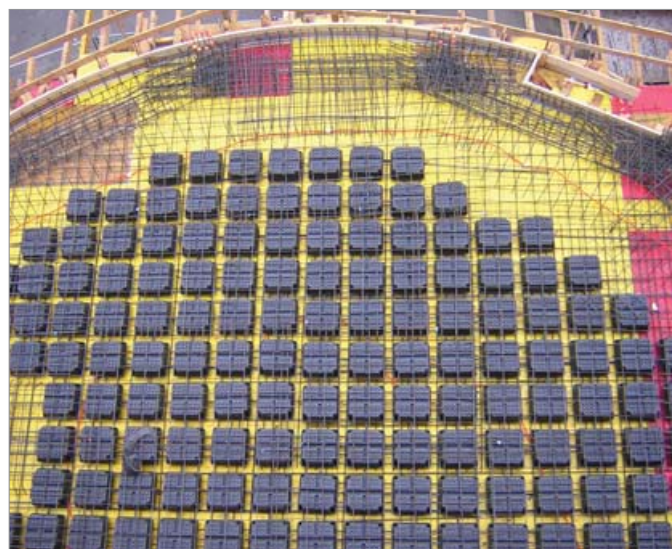


Building for residential use

U-Boot Beton[®] parameter and consumption table

Formwork	Base	Height H	Feet p	Spacers d	Joist width	Joist centre distance	U-Boot incidence	Concrete saving		Concrete consumption
	cm	cm	cm	cm	cm	cm	pcs/m ²	m ³ /pcs	m ³ /m ²	m ³ /m ²
u - 10	52 x 52	10	0-5-6-7-8-9-10	0,8	12	64	2,44	0,021	0,051	0,049
					14	66	2,30		0,048	0,052
					16	68	2,16		0,045	0,055
					18	70	2,04		0,043	0,057
					20	72	1,93		0,041	0,059
u - 13	52 x 52	13	0-5-6-7-8-9-10	0,8	12	64	2,44	0,028	0,068	0,062
					14	66	2,30		0,064	0,066
					16	68	2,16		0,061	0,069
					18	70	2,04		0,057	0,073
					20	72	1,93		0,054	0,076
u - 16	52 x 52	16	0-5-6-7-8-9-10	0,8	12	64	2,44	0,031	0,076	0,084
					14	66	2,30		0,071	0,089
					16	68	2,16		0,067	0,093
					18	70	2,04		0,063	0,097
					20	72	1,93		0,060	0,100
u - 20	52 x 52	20	0-5-6-7-8-9-10	0,8	12	64	2,44	0,039	0,095	0,105
					14	66	2,30		0,090	0,110
					16	68	2,16		0,084	0,116
					18	70	2,04		0,079	0,121
					20	72	1,93		0,075	0,125
u - 23*	52 x 52	23	0-5-6-7-8-9-10	0,8	12	64	2,44	0,049	0,120	0,110
					14	66	2,30		0,112	0,118
					16	68	2,16		0,106	0,124
					18	70	2,04		0,100	0,130
					20	72	1,93		0,095	0,135
u - 24	52 x 52	24	0-5-6-7-8-9-10	0,8	12	64	2,44	0,047	0,115	0,125
					14	66	2,30		0,108	0,132
					16	68	2,16		0,102	0,138
					18	70	2,04		0,096	0,144
					20	72	1,93		0,091	0,149
u - 26*	52 x 52	26	0-5-6-7-8-9-10	0,8	12	64	2,44	0,052	0,127	0,133
					14	66	2,30		0,119	0,141
					16	68	2,16		0,112	0,148
					18	70	2,04		0,106	0,154
					20	72	1,93		0,100	0,160
u - 28	52 x 52	28	0-5-6-7-8-9-10	0,8	12	64	2,44	0,053	0,129	0,151
					14	66	2,30		0,122	0,158
					16	68	2,16		0,115	0,165
					18	70	2,04		0,108	0,172
					20	72	1,93		0,102	0,178
u - 29*	52 x 52	29	0-5-6-7-8-9-10	0,8	12	64	2,44	0,059	0,144	0,146
					14	66	2,30		0,135	0,155
					16	68	2,16		0,128	0,162
					18	70	2,04		0,120	0,170
					20	72	1,93		0,114	0,176
u - 32*	52 x 52	32	0-5-6-7-8-9-10	0,8	12	64	2,44	0,062	0,151	0,169
					14	66	2,30		0,142	0,178
					16	68	2,16		0,134	0,186
					18	70	2,04		0,127	0,193
					20	72	1,93		0,120	0,200
u - 33*	52 x 52	33	0-5-6-7-8-9-10	0,8	12	64	2,44	0,067	0,164	0,166
					14	66	2,30		0,154	0,176
					16	68	2,16		0,145	0,185
					18	70	2,04		0,137	0,193
					20	72	1,93		0,129	0,201

* Composed of two single elements

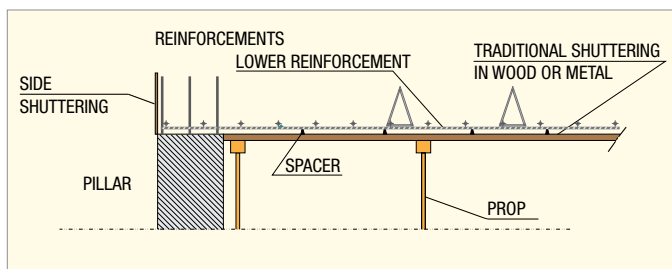


Retirement home

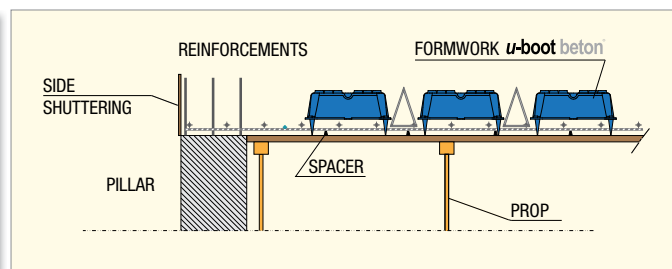


Building for industrial use

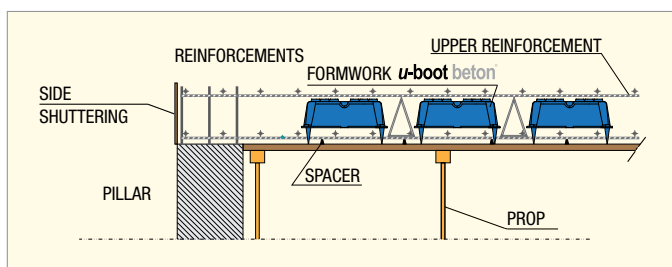
Installation



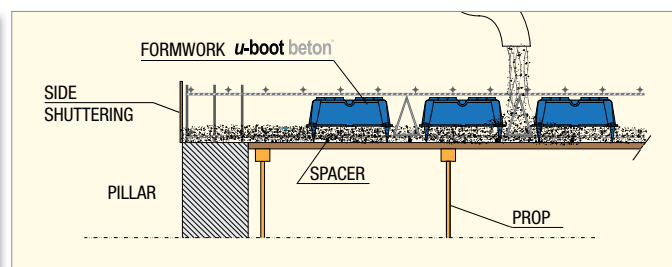
1 The entire surface of the slab to be cast on site is shuttered with wood deckings (or similar systems), then the lower reinforcement bars are positioned in two mutually perpendicular directions according to the design and the lattice for the upper reinforcement is arranged.



2 The U-Boot Beton[®] formworks are positioned using the lateral spacers joints to place them at the desired centre distance that will determine the beam width. Thanks to the conic elevator foot, the U-Boot Beton[®] formworks will be lifted from the surface, making it possible for the lower slab to be formed. If double or triple elements are used, these elements must first be assembled, which will be supplied on distinct pallets in the yard.



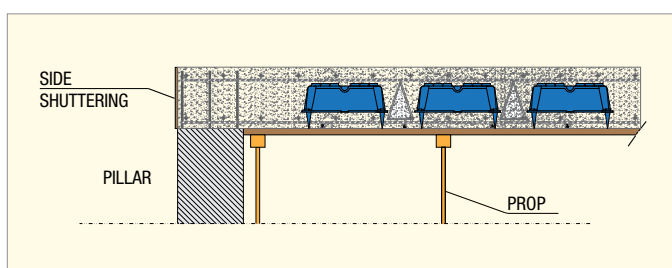
3 The positioning of the reinforcement is completed by placing above the U-Boot Beton[®] formwork the upper bars in the two directions as well as the reinforcement for shear and punching where necessary, according to the design.



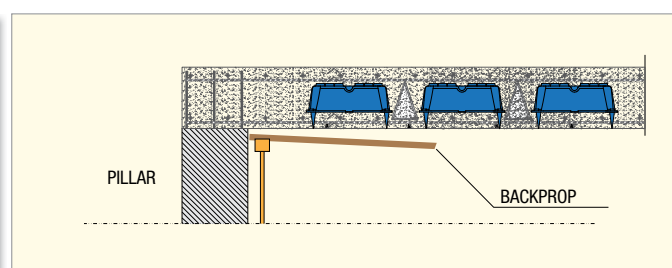
4 The concrete casting must be performed in two phases to prevent the floatation of the formworks: an initial layer will be cast to fill a thickness equal to the height of the elevator foot. Casting will continue for this first portion of the slab until the concrete starts to set and become semi fluid.



Wait a period of time (depending of fluidity of concret and climatic condition) before the second casting of the concrete.



5 Once suitably set, the casting can be restarted from the starting point, completely burying the U-Boot Beton[®]. The casting is then levelled and smoothed in a traditional manner.



6 Once the structure has hardened, the formwork can be removed. The surface is smooth in correspondence of the soffit.



Photographic details of the complete sequence of positioning the scaffolding, positioning the U-Boot Beton[®], reinforcement of the structure to be performed on site, casting and final smoothing.

Application examples

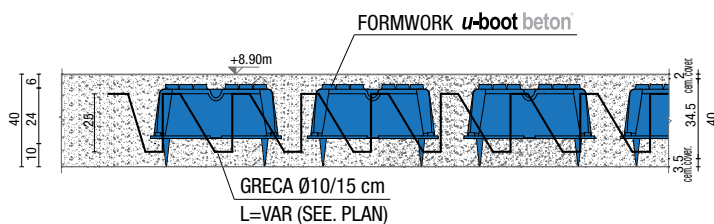


U-Boot Beton® is used for buildings in the **service sector** (hospitals, parking buildings, underground structures, commercial buildings etc), residential **constructions** (especially medium and large sized dimensions) and **industrial constructions** (very thick foundation rafts with a reduced quantity of concrete, *as shown in the figure*).

Main constructive solutions with U-Boot Beton®

- lightened slabs with large span (up to 20 m);
- slabs with atypical and "ambitious" forms;
- overhangs;
- lightened foundation rafts.

U-Boot Beton® application for mushroom slabs



Purpose:

creation of a large span slab with low deformation, avoiding beams with non-standard thicknesses.

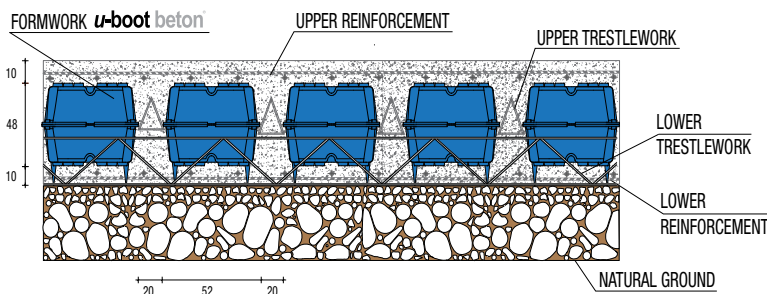
Implementation procedure:

- placing of the lower formwork
- placing of the lower reinforcement
- placing the lattices
- placing the U-Boot® modules between the lattices
- placing the upper and final reinforcement
- concrete casting

Advantages:

- lightens the structure
- less concrete use
- no lowered structures (beams)
- bidirectional structure

U-Boot Beton® application in the case of a foundation raft



Purpose:

creation of very rigid rafts, minimising the quantity of concrete and the foundation weight in the case of inconsistent ground surfaces.

Implementation procedure:

- casting the base (lean concrete)
- placing of the lower reinforcement
- placing the lattice
- placing the U-Boot® modules between the lattice
- placing the upper and final reinforcement
- perimeter shuttering
- concrete casting

Advantages:

- lightens the structure
- less concrete use
- structure stiffness
- decrease on stress on the ground
- elimination of foundation piles

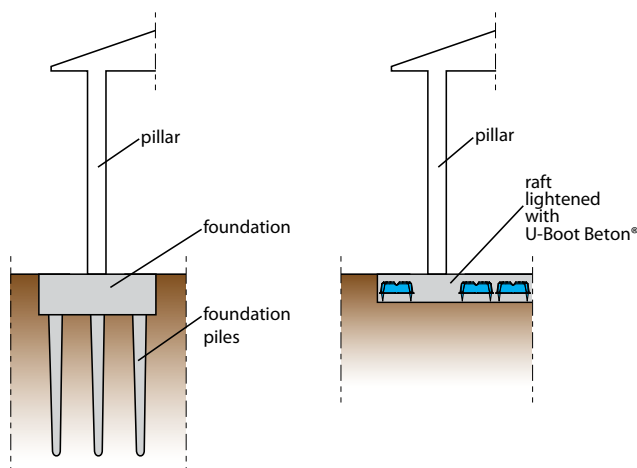
Application examples: rafts

Among the various foundation types, rafts are one of the most well known. They are used above all in ground conditions with little bearing capacity, or with poor quality soil, large thicknesses must be used which increases the construction cost.

Thanks to the use of **U-Boot Beton[®]** lightened rafts can be created with the same performance but at a considerably lower cost.

Once down in the concrete casting, **U-Boot Beton[®]** forms the structure just like two full slabs, with a variable thickness, connected by a perpendicular beam gridwork to form a bidirectional static honeycomb plate.

For this concrete bed, the distribution of weights due to high inertia is rationalised in order to permit maximum stiffness and lightness for the structure with a minimum amount of concrete, which makes it possible to eliminate, where possible, the **foundation piles**.



U-Boot Beton[®] or polystyrene formwork?

Even if polystyrene is widely used in the construction industry due to its low cost and workability, it has many disadvantages that are being addressed by the technical-scientific community.

With reference to lightened slabs, the Italian Ministerial Decree of 16.02.2007 to enclosure D.5.1 establishes that: ***"In the case of polystyrene formworks, or formworks in similar materials, there must be appropriate vents for the overpressures"***. Even prior to this, the UNI 9502 standard - article 7.2.2 - established that: ***"In the case of elements incorporating materials that when subject to high temperatures turn to gas, there must be appropriate vents facing the side exposed to fire to ensure that the bearing capacity is not compromised by explosions"***.

Therefore, using polystyrene slabs cast on site requires the extra expense of fitting vents in the cavity to counteract the excessive pressure of gas that is sublimated by the formwork. However, in the event of a fire there would still be the problem of toxic gas escaping into the environment (styrene).

As **U-Boot Beton[®]** is made of polypropylene, it is not toxic even if burnt. Moreover, the slab will not explode due to the escaping of over pressurised gas from the feet (4 feet for each formwork) that act as safety valves. Tests run at the CSI laboratory have demonstrated that with a cement cover of 3.5 cm the structure created with **U-Boot Beton[®]** is class REI 180. Other advantages of **U-Boot Beton[®]** compared to EPS are the dimensions, handling (just think of transferring it overhead onto the slabs being built) and outdoor storage. Polystyrene is, in fact, bulky and cannot be stacked; it is particularly fragile on its edges and corners that crumble leaving those annoying balls that, statically charged, stick to everything (especially to the reinforcements) and are very hard to get rid of.



Student housing

Environmental compatibility



Daliform Group has again demonstrated to be extremely precise with regard to respecting health and the environment having been the first to obtain **Environmental Compatibility Certification (CCA)** for its products.

This certificate is very important for **U-Boot Beton®** because it demonstrates: **the lack of dangerous substances** in its composition (even if recycled materials are used); the lack of emissivity of toxic substances during the various phases of the product's life and operating cycle, which **benefits the health** of the intermediate users (production and installation personnel) as well as final users (people living in the building) as well as the **environment** in general.

Certifications



- Fire Resistance Certificate REI 180 for U-Boot Beton® issued by the CSI institute in Bollate (MI).
- Certification of a Load Test on a sample with U-Boot Beton® issued by the University of Darmstadt.
- Acoustic test according to the standard UNI EN ISO 140-6 - Measurement of acoustic insulation in buildings and building elements; Laboratory measurements of the insulation footstep noise issued by the Istituto Giordano di Gatteo (FC).
- Acoustic test according to the standard UNI EN ISO 140-3 - Measurement of acoustic insulation in buildings; Laboratory measurements of the insulation of air-borne noise from building elements issued by the Istituto Giordano di Gatteo (FC).
- Loading and breaking test certified by the University of Padua.
- Environmental Compatibility Certification (CCA).
- Member of the Green Building Council Italia.
- System certification pursuant to ISO 9001 - ISO 14001 - SA Standard 8000.

Daliform Group technical office



FEASIBILITY STUDY

Predimensioning and optimisation of the structures, comparative and/or revised proposals, material and manpower estimates, cost analysis.
Evaluation of forced ventilation in the case of cold rooms.

CALCULATION REPORT

Reports certifying the execution of Daliform Group constructive systems.



SUPPORT FOR THE EXECUTIVE DESIGN

Support by design professionals. Upon request, the formwork positioning plan can be supplied with a list of the products required to carry out the work and the relative accessories.

ON-SITE SUPPORT

If necessary, our technical staff can be present on-site to help the construction company during the operational phase.

The technical consultancy is only valid for the Daliform Group construction systems.

To contact the technical office: Tel. +39 0422 208350 - tecnico@daliform.com

To obtain updated technical cards, support material, new photos and case studies, go to www.daliform.com

Specifications

Creation of a bidirectional lightened plate slab in reinforced concrete, type "U-Boot Beton®", to cast on site on suitable horizontal support formworks (or on a prefabricated plate) and accessories.

Total slab thickness is _____ cm lightened in compliance with the design with recycled plastic elements such as "U-Boot Beton®" of the Daliform Group, truncated-pyramid in shape with a crossed, semi-cylindrical notch at the top to house the reinforcement bars or the systems to be integrated in the casting; plan dimensions 52 x 52 cm and H _____ cm, with the four semicircular notched corners at the base of which the conic elevator foot is created, facing down, H _____ cm, resting on the scaffolding to form the thickness of the soffit suitably reinforced with a bidirectional steel rod mesh for reinforced concrete such as B450C with a diameter and pitch adequate for design stresses. It includes the supply and positioning of the "U-Boot Beton®" modules fitted with rigid spacer joints to form a link and thus create the perpendicular beams between the formworks according to the predefined thickness and ensure the perfect geometry and bearing capacity upon casting, to be placed at the top of them inside the notches after installing the metal trestlework (min. 12 cm wide) between the "U-Boot Beton®" modules. Also included is the supply and casting of the concrete (minimum resistance class C25/30, consistency class S5 and diameter of the aggregates such to avoid "segregation" phenomena) needed to create the bottom slab; filling and vibrating first the part under the formworks until the "U-Boot Beton®" feet are completely covered (max 4 cm over them) and then completing the slab as soon as the first layer starts to set (in this second phase a consistency class different from the previous one is allowed).

The "U-Boot Beton®" modules, must be produced in "ALAPLEN® CV30", must be safe to walk on and certified with a resistance characteristic of 150 kg in the weakest point on an 8 x 8 cm support; they must not release any polluting substances and must have an Environmental Conformity Certificate and be produced by a company using an Integrated Management system (ISO 9001, ISO 14001, OHSAS 18001, SA 8000). The executive design of the lightened slabs must have graphs and calculations provided by the company supplying the "U-Boot Beton®" modules that must exhibit technical sheet and safety sheet for the product and for "ALAPLEN® CV30" grain texture and that must also exhibit the product certificate approved by a EOTA member (European Organisation for Technical Approvals).

The manufacturer shall provide an acoustic behaviour certificate that certifies a minimum lowering of air-borne noise of the slab (Rw) equivalent to 56 db and a sound pressure assessment value from walking on the slab (L_{nw}) equivalent to a maximum of 82 db, verified on a 26 cm thick type lightened slab (5+16+5) issued by an accredited Body. With reference to fire standards, the company producing the formworks shall provide a fire behaviour certificate that certifies, for a 25 cm thick type lightened slab (5+16+4), a REI 180 resistance to fire with a moment of stress of at least 4880 Nm and a minimum 3 cm cement cover, issued by an accredited Body.

The cost for the creation of holes with the dimensions and sections foreseen by the architectural drawings is also included, the price also includes and covers all costs for providing the finished work in a workmanlike manner; it does not include the supply and positioning of the horizontal formwork that supports the slab and accessories, the trestlework and the metal reinforcement, which will be entered separately.

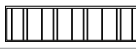
Cost Euro/m². _____

Supply and installation cost grid

No.	Item	U.M.	Quantity	Unit price	Total
1	Supply and casting of concrete fluidity class S5 - thickness _____	m³/m²			
2	Supply of the U-BAHN BETON® formwork	m³/m²	1		
4	Dry positioning of the U-BAHN BETON® formwork	H/m²			
5	Supply and pose of bending reinforcement and shear/punching	Kg/m²			
6	Supply and casting of concrete fluidity class S _____	m³/m²			

Total cost €/m²

Logistics - pallet capacity

MEANS OF TRANSPORT	NO. OF PALLETS	
Tractor (8.20/9.60x2.45)	14/16	
Trailer (6.20x2.45)	10	
Tractor+ Trailer type "BIG" (8.40+7.20x2.45)	14 + 12	
Semi-trailer (13.60x2.45)	24	
20 feet container	10*	
40 feet container	20*	

* the m² per pallet can vary based on the type of container.

The information contained in this catalogue could be changed. Before placing an order, request a confirmation or updated information from the DALIFORM GROUP, which reserves the right to make changes at any moment without notice. In consideration of recycled material, it is specified that there are tolerance margins caused by environmental factors.