

OPERATING INSTRUCTIONS

MANUAL FOR CONTINUITY SYSTEM

(STANDARD SLEEVES with injection vent M12)



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YOU ARE RECOMMENDED TO READ CAREFULLY THE INFORMATION AND PRESCRIPTIONS CONTAINED IN THIS MANUAL BEFORE USING ANY PART OF THE CONTINUITY CONNECTION SYSTEM, COVERED BY INTERNATIONAL PATENT.

For any doubt regarding the correct use of the components described in this manual contact B.S. Italia S.p.A:

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B.S. Italia S.p.A. is a ISO 9001 certified company and the CONTINUITY CONNECTION SYSTEM is designed and manufactured according to:

- Reference standard: Eurocodes EC2, EC3, EC8.
- Italian code D.M. 9/01/96 "Technical standards for the calculation, execution and validation of reinforced concrete structures, normal and pre-stressed, and for metal structures".
- Italian code D.M. infrastructures and transport 14/09/2005 "Technical standards for constructions".
- Italian code D.M. 14/01/2008 " Technical standards for constructions".
- For general parts: Eurocodes and state of the art.
- For materials and surface treatments: ISO, EN, DIN, UNI STANDARDS.
- For Quality System: ISO 9001 through IGQ (n° IT-0188).

B.S. Italia S.p.A even carried out the following system validation tests at:

- Department of Structural Mechanics, University of Pavia.
- EUCENTRE (European Centre for Training and Research in Earthquake Engineering) in Pavia.
- RTM Breda (Research Testing Materials Accredited Institute).

B.S. ITALIA S.p.A. CERTIFICATIONS





SYSTEM FEATURES

The connection between the columns and the foundation works, the junction between two portions of a column, the connection between precast concrete walls and foundation works represent some of the issues related to the union between concrete elements (precast or not).

The **CONTINUITY CONNECTION** system developed for the connection between precast concrete columns and foundation works, between two portions of precast concrete columns, between wall and column or column and beam is able to achieve a mutual interlocking constraint between the elements, restoring the structural continuity of the reinforcing bars without requiring the overlapping and introducing in the precast concrete industry new and interesting innovations. These allow a quicker and immediate use of the system, speeding up the precision of the installation and enabling an engineering optimization of the behavior of the metal inserts inside the concrete elements.

The **CONTINUITY CONNECTION**, seismic resistant system between concrete elements, guarantees the direct transfer of the forces between two rebars, eliminating the need to overlap the bars and any eccentricity in the junction components or internal bars of the concrete elements. This kind of connection, perfect emulation of cast in place structures, is an ideal solution in terms of seismic performances.

The **CONTINUITY CONNECTION** system exploits the concept of adhesion (via a concrete matrix) between rebars and sleeve thus guaranteeing a perfect continuity between concrete elements typical of the cast in place structures.

The bulk of the system consists of a metal sleeve, with a double adherence world first time (internal and external) to concrete in order to avoid its pulling out: so that between sleeves, grout, rebars and concrete, the Continuity System triggers an ideal transfer of forces.

The **CONTINUITY CONNECTION** system is particularly appropriate to connect precast concrete structural elements (foundation / column and column / column). The components of the system are housed in concrete elements at the time of their production. Once on constructions site and coupled the elements, it will be sufficient to seal with grout, by predetermined characteristics, to ensure the structural continuity of the concrete products.



The innovation of the new B.S. Italia CONTINUITY CONNECTION SYSTEM allows the overcoming of all today intrinsic limitations in the connections between concrete elements, offering the achievement of key goals for a good structural design:

High coupling tolerance	It ensures a quadruple tolerance compared to coupling systems in the market.
Ductility guarantee	High-ductility steels are used.
Excellent fire resistance	The seismic resistant connection system by B.S. Italia is properly covered and therefore protected by the concrete of the element.
Vertical height adjustment	The system allows for adjustment of the height and verticality of the element to absorb eventual mistakes in foundations casting.
Anchoring in foundation	Guaranteed by foundation reinforcement itself that continues towards the column (perfect emulation of the cast in place structures).
Fixing set	The locking of the sleeves is proposed by a dedicated fixing and centering system connectable to the metal template. The metal templates are therefore fundamental for the correct positioning of the inserts. B.S. Italy S.p.A., may offer, by a commercial agreement, a dedicated consulting service for the design/manufacturing of the templates and a technical assistance at the precast concrete manufacturer and or at construction site.
Structural calculation It is not necessary given	the guaranteed emulation of traditional cast in place solutions. The system guarantees perfect continuity of the reinforcement between two concrete reinforced elements (eg. Column-foundation). The connection creates a guaranteed structural continuity and therefore does not require any other additional calculation charge.
Warning:	The products that B.S. Italia S.p.A produces and supplies, are designed as an indivisible system for the connection of reinforced precast concrete elements <u>THE CONTINUITY CONNECTION SYSTEM</u> by B.S. ITALIA IS CERTIFIABLE BY THIS COMPANY ONLY IF IT IS MADE UP WITH ALL ORIGINAL COMPONENTS AS REPORTED IN THIS MANUAL, INCLUDING THE GROUT B.S. GROUT.
	B.S. Italia S.p.A reserves the right to implement any design changes inherent to the whole CONTINUITY SYSTEM at any time and with no obligation of notice.



DESCRIPTION OF THE SYSTEM

The purpose of this document is to explain to the end user how to properly install the **B.S. Italia CONTINUITY CONNECTION SYSTEM.**

The file is divided into two parts following the logic of production and erection of precast concrete elements.

The first part deals with the production phase of the elements in the manufacturing plant. It explains how to properly install the items that compose the system by anchoring them to the steel reinforcements, their subsequent insertion into the mould for casting phase and the final demoulding of the centering systems.

The second part deals with the erection phase of the precast concrete elements. It explains how to position the columns above the foundation and / or lower column, and how to create the mould to cast and inject the grout.

Each part described below is divided into two separate sections: the first where supplied components and accessories are shown and described while the second provides the operating instructions for system assembly.



PRODUCTION PHASE AT THE PLANT

A. COMPONENTS OF THE SYSTEM





A1. SLEEVE (1)

The metal sleeve has the function of creating the continuity of bars housed inside it. Its geometry is designed to promote adhesion both inside and outside the concrete. This allows to the sleeve an adherence mechanism more similar to a rebar rather than that of a classic metal insert.

The double adherence, unique feature at international level, in addition to avoiding the interruption of reinforcement and stirrup in a critical area such as the junction of columns / foundation and / or column / column, also exploits the outer adherence of the sleeve related to the concrete for a more optimal transmission of the internal actions.

The sleeve, by length L = 480 mm and \emptyset 80 mm maximum outside diameter, is provided with a threaded lower hole to accommodate the lower fitting (made of PVC or metal according to different projects) containing the non-return valve (through which injecting the grout) and a threaded upper hole to accommodate the M12 screw (once removed from the concrete element, it will allow the grout vent). In some special supplies, the lower hole may not have the external flange.





A2. LOWER FITTING FOR INJECTION (2) (3)

The lower fitting for injection allows the easy injection of the grout using a pump.

The fitting consists of 2 different items:

- Hex threaded fitting ②:
 With the aim to allow the filling of the sleeve. Inside it is placed a non-return valve to avoid the leakage of the grout once the injection process is completed. The hex threaded fitting can be, at the request of the Customer, made of PVC or metal.
- Plastic cap with flat head ③:

With the aim to protect the fitting from the accidental filling with the concrete during casting of the concrete element. The cap may be provided, according to the supply, in different models and colors.



PAY ATTENTION: for some supplies B.S. Italia may provide the plastic cap with flat head ③ already coupled with the hex threaded fitting ③.



A3. PROTECTION FOAM FOR LOWER FITTING 4

The protection foam (4) for lower fitting has a double purpose: protecting the fitting during the concrete casting phase and make the system adaptable to different steel covers required by the specific project.

To achieve this result, B.S. Italia provides a foam protection about 60mm long, which allows to cover a distance sleeve-axis mould-side up to about 104 mm. The foam protection must be cut (by a cutter) in order to conform to the specific needs of each project. In some supplies, B.S. Italia may provide protection foams with different lengths in respect of what reported above.



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A4. UPPER FITTING FOR INJECTION VENT (5) (6) (7)

The upper fitting for injection vent allows, after removing the protection foam and screw from the concrete element, the outflow of the air while injecting the grout with the pump and allows to check when the sleeve is completely filled in.

The fitting is composed of 3 different items:

- A spring (5): With the aim to avoid the screwing of the screw itself inside the sleeve (thus ensuring the position against the side of the mould).
- An M12 screw with cylindrical head and hexagon socket (6): With the function to create a cavity in the concrete element needed to allow the outflow of the air while injecting the grout. The cavity is obtained by removing the protection foam and unscrewing the screw from the concrete (after casting the item and with hardened concrete). The length of the screw may vary from project to project, and according to the different lower fitting used, as it has to adapt to the specific position of the sleeve.

In general terms and just as reference please consider the following framework:

- the M12x35mm screw (6) in combination with the PVC lower fitting (2) (3) is suitable for sleeves far from the edge (in respect of its axis) from 75 to 84 mm.
- the M12x35mm screw (6) in combination with the metal lower fitting (2) (3) is suitable for sleeves far from the edge (in respect of its axis) from 70 to 84 mm.
- the M12x55mm screw (6) in combination with the PVC or metal lower fitting (2) (3) is suitable for sleeves far from the edge (in respect of its axis) from 85 to 104mm.
- Protection foam ⑦ for screw: with the function to protect the hexagon socket of the screw (during casting of the concrete element) and ease the identification/extraction of the screw (before the phase of grout injection).





A5. UPPER RUBBER SEAL (8)

The upper rubber seal (3) placed at the top of the sleeve has the function to seal the empty spaces between sleeve and rebars. According to project diameters, two kinds of seals are available which perfectly fit to the reinforcements: the former allows to install the system on rebars with a diameter included between \emptyset 16 and \emptyset 22 while the latter has a variable diameter included between \emptyset 24 to \emptyset 32.





A6. FIXING AND CENTRING SYSTEM FOR SLEEVE (9) (10)

The fixing and centering system (9) (10), composed of two items, has two functions: ensuring the correct position of the sleeve to the rebar and fixing tightly the system to the template. It is suitable for rebars with a diameter between 24 and 32 mm. An adapter is available for rebars with a diameter <24 mm, upon request.

The fixing system is composed of the following two items:

 A hollow cylinder (9) with a magnet inside: with the function to center precisely the sleeve to the rebar in the reinforcement cage.

The presence of a magnet inside the cylinder allows a stable anchoring of the fixing set to the reinforcing bar.

 Fixing socket 10: with the aim to fix tightly the Continuity System to the template in order to respect millimetrically the position of the rebars.





A7. STOPPER CLOSING FOR INJECTION END (reusable) (1)

The stopper closing for injection end (1) has the function to avoid the out flow of the grout not yet hardened and to make the sleeve hermetic.

This stopper, to be used only during the injection phase of the Continuity System, can be reused once the grout has hardened (24 hours). The stopper can be supplied in different colors and models.



PAY ATTENTION: B.S. Italia supplies the closing stopper (1) together with all the items needed to complete the sleeve. Since this stopper is needed after grout injection phase, it is recommended to keep it in dry and secured place.



B. OPERATING INSTRUCTIONS FOR SLEEVE INSTALLATION IN THE REINFORCEMENT CAGE

The purpose of the following chapter is to explain to the end user how to properly install the **CONTINUITY SYSTEM** supplied by B.S. Italia S.p.A. on the rebars of the precast concrete element.

B1. INSTALLATION OF THE LOWER FITTING FOR INJECTION





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Insert in the lower fitting (2) (in the side where the non return valve is visible) the plastic cap with flat head (3) ensuring to make it perfectly adhere to the fitting (to avoid that concrete, during casting phase, may flow into the fitting obstructing it) and checking that during installation no damages have occurred.

PAY ATTENTION: for some supplies B.S. Italia might provide the plastic cap with flat head (3) already coupled with the hex threaded fitting (2).

- Screw the lower fitting (2) (with related cap(3)) in the lower hole of the sleeve (1).

NOTE: make sure that the lower fitting is perfectly screwed to the sleeve in order to guarantee the hermeticity of system installation.

PAY ATTENTION: During the screwing operation, be sure to tighten the lower fitting working on the hex nut against the sleeve without touching the real valve (in order to avoid potential damages of the inner valve which prevents the reflux of the grout).





- Place the foam protection ④ on the external side of the lower fitting to guarantee both protection and exact distance of the sleeve from the mould.







B2. INSTALLATION OF THE UPPER FITTING FOR INJECTION VENT (5) (6) (7)

- Take the spring (5) and insert it into the M12 Screw (6).
- Screw the spring with screw (5) (6) inside the upper hole of the sleeve (1) by a few mm (about 5 mm).



- At this point screw the spring with screw (5) (6) up to it reaches the desired measure considering that:
 - the length of the screw may vary from project to project and according to the kind of lower fitting used.
 - The protection foam occupies a couple of mm against the mould side.

Here below a detailed drawing.



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- Insert the protection foam (7) on the head of the screw (6), making sure to fit it perfectly (to avoid that concrete, during casting phase, may flow into the hexagon, obstructing it).





B3. INSTALLATION OF THE UPPER RUBBER SEAL Ø40 (8)

This operation has to be performed only when the rebar, entering into the sleeve, has a $\emptyset < 30$ mm. With rebars \emptyset 30-32 mm, don't install the rubber seal \emptyset 40 on the sleeve but install the rubber seal on the rebar reinforcement and follow the instructions described in paragraph B5).

Insert the upper rubber seal at the top of the sleeve 8. Place it at the opening of the sleeve and push it inside it until reaching the rim in relief.

The seal (8) has a double aim: to lead the operator during the subsequent insertion phase of the sleeve and create a restraint to avoid that the next cast of liquid concrete penetrates inside the sleeve

PAY ATTENTION: pay attention that the black rubber seal (8) perfectly adhere to the sleeve checking that during installation phase no damages and / or strains occurred in the rubber.





B4. INSTALLATION OF THE FIXING AND CENTRING SYSTEM FOR SLEEVE (9) (10)

Preliminary visual check:



Check the cleaning of the hollow cylinder (A), the magnet placed in the bottom of the hollow cylinder (B) and the absence of impurities in the thread of the bar (C) placed on the bottom of the cylinder. Since the fixing systems are reusable this verification and cleaning operation is necessary in order to ensure the smooth extraction of the insert after the demoulding of the concrete element.



2. Check that the fixing pins ① of the fixing set are fully retracted in the cylinder body ⑤. If not, unscrew the hexagonal bar ⑥ placed on the bottom of the hollow cylinder as long as the pins are not retracted.

N.B.: Make sure that the O-Ring G that holds in place the fixing pins is not worn, torn or damaged. If damaged it is recommended to replace it making sure to place it securely inside its carved seat H into the main body of the insert.



Insert the hollow magnetized cylinder (9) in the lower part of the sleeve (1) until the cylindrical washer (1) comes into contact with the bottom. (the cylindrical washer (1), according to different projects, may have a rubber washer first).



Screw the hexagonal bar until it resists and make sure the cylinder is securely housed inside the sleeve. If properly installed, the conformation of the sleeve will prevent the fixing set pulling out from its location.





In order to prevent the threaded rod \bigcirc from rotating while screwing the fixing system on the sleeve, it must contrast the rotation either with a screwdriver or an allen wrench (depending on the model supplied).



Apply the liquid release agent to the threaded bar, the cylindrical washer and the hexagonal bar to prevent the concrete, during casting stages, may adhere and obstruct the extraction of the insert after demoulding.





B5. POSITIONING OF THE SLEEVE ON THE REBARS

Preliminary operations:

- Check that the rebars are installed correctly in the cage; in order to verify this you can use the template supplied by B.S. Italia (or built by the customer according to its production drawings) as a "Go-No gauge" device. If there were shifts of the reinforcement, a repositioning inside the cage must be performed.
- Align all the rebars of the reinforcement cage so that all the sleeves, once placed correctly in their position, have a unique supporting plane.
- Mark all the rebars that will have to receive the sleeve to get a visual feedback of the correct execution of the operation. By a pencil draw a mark on the rebars at <u>240 mm</u> from the end of the bar itself.



At this point,

- For rebars Ø < 30 mm: Insert, on the side of the black seal, the sleeves on the rebars up to the rebar touches the bottom of the hollow cylindrical body (the magnet on the bottom helps to keep the sleeve in place).
- For rebars with Ø 30-32 mm: first put the black seal directly on the rebars orienting it properly (see picture below) and by positioning the flange up to the mark previously drawn. Now put the sleeves into the rebars as described above, checking carefully that the black seal is correctly placed in the sleeve.







Put in the sleeves on the rebars marked 240 mm and turn the sleeves orienting the direction of the injection and vent fittings according to the fabrication drawings that are provided for the project. Check carefully that the black seal is positioned at the height of the mark just traced. Only when do this happen it will be assured that the sleeve is perfectly fitted on the rebar.





PAY ATTENTION: In order to avoid eventual leaks of liquid concrete during the casting phase, <u>it is</u> <u>recommended</u> to seal the area between the rebar and the black seal, both to make it more hermetic and avoid displacement of the sleeves during the handlings for placing in the mould.





Place the closure template by passing both the threaded bar and the hexagonal bar of the sleeve through the centering holes.

WARNING: Carefully check that during the positioning of the template there is no friction on the threads of the bar protruding from the sleeves (to prevent, during demoulding, the hexagonal bar from blocking and so avoiding the removal of the fixing set).





Fully screw the fixing sockets 10 on the threaded bar of the fixing set 9 to securely fasten the Continuity system to the head template. This operation allows to respect millimetrically the position of the reinforcing bars as shown on the project drawings.





Complete the construction of the reinforcement with the stirrups provided for the column portion affected by the presence of the sleeves. For the geometry, the pitch and the diameter of the stirrups, it must refer to the construction drawings of the project.



WARNING: carefully check that the M12 screws protrude from the sleeves respecting their design positions (to ensure the insertion of the reinforcing cage in the mould and the subsequent contact with the side walls). The same verification must be performed for the protection foams (for the lower fitting).



C. OPERATING INSTRUCTIONS TO CAST AND DEMOULD THE PRECAST CONCRETE ELEMENT

C1. POSITIONING OF THE REINFORCEMENT CAGE INTO THE MOULD

During all the phases of insertion inside the mould pay great attention not to spoil, crush and / or damage the sleeves and their accessories.

ATTENTION: <u>At the end of this operation</u> <u>check scrupulously that all the foams and caps of the</u> <u>sleeves (both upper and lower ones) touch perfectly the wall sides of the mould (on the contrary proceed to settle this).</u>

C2. CASTING OF THE LIQUID CONCRETE

During the casting phase avoid spilling of the concrete just over the sleeves, to prevent the displacement and / or deformation of the foams/caps.





After casting it is recommended to clean the foams/caps protruding in the direction of the casting face.



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C3. REMOVAL OF THE TEMPLATE AND FXING SET

When concrete is hardened and before demoulding the column, unscrew the fixing sockets 0 and remove them from the fixing set. If during casting phase some liquid concrete has deposited on the threaded bar, before starting the unscrewing operation of the fixing sockets, it is recommended to remove all the dirt by a steel brush.

Remove the centering template from the bottom of the element paying attention not to spoil the thread of the threaded bars of the fixing set 9.

After removing the templates, remove the fixing sets 9 by unscrewing the hexagonal bar F placed at the bottom of the hollow cylinder up to the pins come back to their seat.

Pull out the fixing sets from the sleeve and proceed with the related cleaning of the washers.



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Check the sleeves are without any dirt and liquid concrete formed during casting phase; otherwise proceed with the complete removal of dirt and liquid concrete.





C4. REMOVAL OF THE FOAMS, CAPS AND SCREWS AFTER DEMOULDING

Remove from the sleeves:

- the foams (4) placed in the lower position and then the plastic caps (3) which protect the entrance of the fittings (using a sharpened tip or a screwdriver).
- the foams ⑦ placed in the upper position (using a sharpened tip or a screwdriver) and then unscrew the M12 screws ⑥ (using an allen wrench) removing them completely from the concrete element.

ATTENTION: verify that the cavities created in the concrete element are dirt free.





C5. CONTROL OPERATIONS AND CLEANING AFTER FORMWORK REMOVAL

Before column installation phase at construction site, make sure that both the holes of the sleeves, the one of the lower injection and that of the upper vent, are completely free and without any obstruction.

Clean by means of compressed air and / or water under pressure by insufflating it both through the vent hole and the injection one.

Carry out even a visual inspection of the internal cavity of the sleeve in order to exclude the presence of cement slurry or unknown material deposited during the casting and / or transport stage.



If the injection and vent holes are obstructed, it is possible to proceed according to different operating methods: Insert a steel pin in the hole to completely free the eventual obstructions. If it is not possible to remove the obstruction, proceed with the total removal of the vent tube itself by means of a drill bit suitable for drilling metal.



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ERECTION PHASE AT CONSTRUCTION SITE

D. OPERATING INSTRUCTIONS FOR THE ERECTION OF THE PRECAST CONCRETE ELEMENTS

This second part of the operating instructions manual has the aim to guide the workers during erection phase in order to perform correctly both this operation and the following casting and injection phase of the grout.

D1. CHECKING OF THE RENFORMENTS LENGHTS PROJECTING FROM THE FOUNDATION / LOWER COLUMN

This is a preliminary operation but essential for the correct erection of the precast concrete elements.

It must be checked that the reinforcement of the lower part to be joined has the correct length. This check is critical since too long protruding reinforcement may interfere with those in the sleeve of the element to be installed and making it impossible to plumb the system.

All the rebars lengths (L) must be checked, making sure they are equal to (p+240) mm (where "p" is the distance between the concrete elements). On the contrary, it is needed to cut the rebar by an angle grinder, equipped with specific disc for steel cutting, up to reach the required measure. (the cutting by oxy fuel processes through oxy-acetylene torch must be avoided).





D2. POSITIONING OF STEEL SHIM PLATES

Before placing the upper column on the foundations or lower column, it is required to clean both the supporting plane and the rebars by carefully removing any trace of rust, dust and any deteriorated concrete part. Moreover, remove any trace of grease, oil or paint before proceeding with the erection phases. Also make sure that the bars are perfectly clean.

Interpose, between the two concrete elements the steel plates (or made by other material with same stiffness) with thickness "p". The aim is double: both create a regular, certain and sharp supporting plane, and compensate the height differences between concrete elements.

The standard thickness "p" of the plates to be interposed to compensate the height differences, can vary according to different needs of the project, the dimensions of the cross section of the elements to be joined and different inserts used.





In particular, it is noted that:

- For a connection composed <u>only of sleeves</u> (as described in this user manual), <u>the recommended standard thickness of the plates "p" is:</u>
 - <u>30 mm and the height tolerance (between concrete elements) is equal to + 25mm / -</u> <u>10mm for elements with cross-sectional dimensions of up to 800 mm;</u>
 - <u>40 mm and the height tolerance (between concrete elements) is equal to + 25mm / -</u> <u>10mm for elements with cross-sectional dimensions greater than 800 mm;</u>
- For a connection with <u>sleeves in combination with Continuity System RS25</u> (see the related user manual),

the recommended standard thickness "p" of the plates is 60 mm and the height tolerance (between concrete elements) is equal to + 25mm / -10mm.

For a connection with <u>sleeves in combination with vertical control system</u> (see the related user manual or data sheets),
 <u>the recommended standard thickness "p"</u> of the plates is 50 mm and the height tolerance (between concrete elements) is equal to + 25mm / -10mm.

ATTENTION: For the thickness of the plates and their tolerances, please refer to the fabrication drawings provided for the specific project.





It must be considered that:

- In the event of non-compliance with the minimum tolerances given above, the protruding rebars from the bottom of the element could interfere with those placed inside the sleeves of the upper element.
- In the event of non-compliance with the maximum tolerances given above, the rebars of the lower element have not enough length to ensure the complete restoration of the structural continuity guaranteed by the connection after grout injection.

ATTENTION: During the mortar injection phases, complete and perfect filling of the joint with thickness "p" between the elements must be guaranteed.



D3. POSITIONING OF THE UPPER COLUMN

Move slowly downward the concrete column making sure that the rebars, protruding from the lower element, squeeze inside the sleeves and proceed by lowering the column up it touches the steel shims.









D4. PLUMBING OF THE UPPER ELEMENT

Once the precast concrete element is placed on the metal plates, proceed with the plumbing of the element and adjusting its planimetric position.

During the whole operating phase, the element must remain hooked to the crane. The latter, for safety reasons, should NEVER fully discharge the weight of the element on the shims but keep a part of the load (no less than 10% of the weight).

Various B.S. Italia solutions are available to plumb the elements. For the correct use of each solution refer to the related user manual.

- Reusable verticality System





- Internal verticality System



- RS verticality System



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As secondary option, you can proceed to plumb the elements even using suitable telescopic adjusting props, which are supplied by the Client.



After completing the plumbing phase of the element and checking the stability of the system, it is possible to unhook the element from the crane.



D5. POSITIONING OF THE COLLAR TO GET THE CASTING MOULD AND CONSEQUENT FILLING

In order to proceed with the filling of the gap between the two precast concrete elements just erected, it must proceed with the execution of a suitable mould for containing the grout. For this aim, place a hermetic metal mould made by B.S. Italia, or alternatively, depending on the contractual agreements, in accordance to the production data sent by B.S. Italia.

This mould has such dimensions as to fit perfectly to the precast concrete elements, is composed of two parts joined together by screws that secure its monolithic nature. To ease the erection of the column both half-moulds are equipped with hinges that allow the easy assembling. The presence of appropriate inlets on two opposite sides of the mould allows to easily pour the needed grout and fill in the gap.



















Wet the casting base with clean water until saturation before starting the operation of grout casting and wait until the excess water has evaporated or absorbed.

ATTENTION: For the correct preparation of the grout, follow the instructions shown in the dedicated section of this manual.

SUGGESTION: To avoid grout leaks from the mould it is recommended to seal the outer perimeter of the metal mould with polyurethane foam and / or silicone. This operation is necessary especially in case of columns connection on cast in place foundations because the casting can also have broad surface irregularities that would favor grout leakage which hasn't hardened yet.





Now begin the filling operation of the gap. This is done by pouring the grout directly from the bucket where is prepared. For best results we recommend filling in a continuous way, without leaving significant time intervals between a bucket and the next one. The higher the temperature is the more this arrangement must be put into practice. For this reason, in the warm period <u>it is not recommended</u> to run the filling during the hottest hours of the day. It is better to proceed in the late afternoon, to prevent hardening of the grout while pouring it during the hottest hours.

WARNING: If during the casting phase, or immediately after, it rains, it is recommended to protect the mould with tarpaulins to avoid the rain washes the grout not yet hardened.

NOTE: To achieve a complete filling of the gap without voids caused by air entrapment it is prescribed to pour the grout from one mouth, the biggest one. End the filling operation when the grout starts coming up from the vent opening (the smaller one).

MANDATORY: Before starting the filling operation, run the **flow table test** as described in the following paragraph E6.





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NOTE: To accomplish the filling of the gap it is also possible to use the injection pump.

ATTENTION: During the mortar injection phases, complete and perfect filling of the joint with thickness "p" between the elements must be guaranteed.

Any small concrete leak and stains occurred during the grout injection phase can be removed by wiping the area with a paint-brush dipped in water. Remove the reusable metal mould when the grout has hardened (after about 12 hours from casting) taking great care not to damage it and clean it carefully.

If any excess grout is present, it can be removed with the use of a chisel; similar operation must be done to remove the pockets created from the filling inlets of the grout.





D6. FILLING IN OF THE SLEEVES WITH MECHANICAL INJECTION OF THE GROUT

After completing the sealing at the base of the column, proceed with filling of the sleeves. This operation must take place using a specific injection pump with technical specifications defined by B.S. Italia as reported in the following section. Before injecting, check that the injection (lower) and vent (upper) valves are completely free of grout impurities and foam residues. Subsequently insert the injection pipe of the pump inside the injection valve and start the filling after having opened the tap of the pump.



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Remove the injection tube only after the grout begins to come out from the upper vent, and the outlet mouth is closed by inserting the closing stopper of injection end (1). These stoppers are reusable and can be removed after the grout has hardened, after about 12 hours from casting. The stoppers can be supplied in different colors and models, according to different projects.



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Any small concrete leaks and stains occurred during the casting phase can be removed by wiping the area with a paint-brush dipped in water.





ATTENTION:

AFTER ERECTING THE PRECAST CONCRETE ELEMENT AND CHECKING THE PERFECT "PLUMBING", IT IS NEEDED TO FILL IN THE SPACE BETWEEN THE CONCRETE ELEMENTS AND GROUTING OF THE SLEEVES, BY USING EXCLUSIVELY THE HIGH-PERFORMANCE BS GROUT. THE GROUTING AND FILLING OPERATION IS TO BE PERFORMED MANDATORILY BEFORE ERECTING THE OTHER PRECAST CONCRETE ELEMENTS THAT DISCHARGE THEIR WEIGHT DIRECTLY ON THE PRECAST CONCRETE ELEMENT CONCERNED. IN ORDER TO PROCEED WITH THE INSTALLATION OF THE SUPERSTRUCTURES IT IS NEEDED THAT BS GROUT REACHES A MINIMUM RESISTANCE NOT LESS THAN 28 MPa (guaranteed value after about 24 hours from grout casting with a constant room temperature of 20°C).

B.S. ITALIA S.P.A. DECLINES ANY RESPONSIBILITY AND LIABILITY IF THIS MANDATORY PRESCRIPTION OF INSTALLATION AND GROUTING PROCEDURE IS NOT FULLY RESPECTED.

- For the correct preparation of the grout, follow the instructions mentioned in the specific section of this manual.



D7. PROCEDURE IN CASE OF OBSTRUCTION OF THE INJECTION HOLE

If there are impurities close to the lower injection valve, or if, due to the normal installation tolerances, it is found that the rebar to be connected is located right in front of the injection hole, the grout injection phase may be difficult.

In such cases it is possible to proceed in different ways.

- Mix the grout BSGrout using the maximum water / cement ratio indicated in B.S. Italia S.p.A. manual (3.4 liters of water per powder bag).
- Eliminate the small tube through which you perform the injection. By a drill you may "erode" the plastic (or pull it out) and you get a larger hole which eases the BSGrout injection. With this operation, the non-return valve, inside the injection tube, is removed: once you have the complete filling of the sleeve (indicated by grout spilling out from the vent tube), manually close the injection hole with plastic caps, paper or other suitable material.



Demolish the concrete of the column in the injection hole area so as to allow the inclination of the injection nozzle. This operation should allow to inject the grout by making it pass alongside column's rebar.





If it is not possible to free the injection hole or if grout injection is difficult, you may make a hole above the injection hole. By this hole (minimum diameter Ø25 mm) at about 250 mm from the column base, it will always be possible to inject the grout because in this area of the sleeve the column's rebar is kept in the correct position by means of the of the centering system used in the production phase of the column.





The injection by the electric pump must be done using the new hole, after sealing of the bottom hole in order to avoid that the grout may get out. Following this procedure, during the filling phase of the sleeve it is advisable to make local vibrations, for example by hitting with a hammer the injection area, in order to ease the air leakage through the upper vent.





E. OPERATING INSTRUCTIONS FOR GROUT MIXING

This section describes both equipment and operations to be put in place to mix properly the high-performance cement based grout, B.S. GROUT, provided by B.S. Italia.

E1. GROUT IN 25KG BAGS

The grout is supplied packed in polyethylene bags 25 kg each and placed on pallets (one pallet about 1250 kg weight). All instructions for correct storage of the grout and quantity of water needed for proper mixing are reported on each bag and described in the next section E5.



flexural strength:

after 1 day > 7 N/mm²;
 after 7 days > 10.5 N/mm²;
 after 28 days > 12 N/mm²;

• Resistance to freeze / thaw cycles with deicing salts (EN 13687-1) accession after the cycles > 3 N/mm².

NOTES FOR STORAGE: The grout bags must be stored in a suitable environment. The bags must be protected from rain and bad weather and avoid a prolonged exposure to direct sunlight. Moreover, it is recommended to delimit the storage area to prevent accidental impacts that can damage the polyethylene packaging. If during the grout preparation phase, there is the presence of damages in the bag you should not use this grout as it may have lumps and grains altering the mechanical performance of the final product.



E2. DRILL MIXER

For the preparation of the grout you need to mix the mixture carefully. This is achieved with the use of a drill mixer - with suitable power - equipped with a mixing whip.



SUGGESTION: For a best result, we recommend using a mixing whip with a terminal part shaped with overlapping helical coils instead of those with a terminal equipped with vertical arms radially arranged; this since the helical shape allows a more homogeneous mixing, by creating within the liquid both a rotational movement and a rising flow that facilitates both the shuffling and the homogenization.





E3. BUCKETS AND WATER DOSER

For the preparation of the grout it is necessary to have some clean buckets, with capacity equal to at least 30 liters, and a water doser measuring at least 3.5 liters capacity and with a graduated scale to dose accurately the water in the mixture.

CAUTION: During the casting and injection operations of the grout it is recommended to clean immediately the buckets to avoid the hardening of the grout that remains on the edges of the buckets during the mixing phase.

Moreover, during mixing the grout that is being deposited on the sides of the bucket has to be removed with a putty knife or a trowel and added to the mixture.





E4. INJECTION PUMP

In order to fill in the sleeves of the Continuity System, use an injection pump with rubber fitting pipes with minimum diameter 1" and appropriate tap with an injection nozzle placed on the casting terminal.

B.S. Italia S.p.A. recommends the use of a pump type: **SCREW PUMP SP-20**





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Injektionstechnik



Advantages

- Big material passages high flow rate
- · Cone-shaped material container self-emptying

Technical data

Supply	230 V
Motor power	1,8 kW
Working pressure	max. 15 bar
Delivery – infinitely variable	0 – 13,5 l/min
Filling height	89 cm
Grain size	max. 3 mm
Weight	26 kg
Height/width/length	(cm) 90/52/80

Screw pump SP-20

Description

Screw pump SP-20 is of multiple use and features high power combined with compact design. With the delivery control the pump can be controlled continuously from standstill to maximum speed. As an option the delivery control can be fixed with an extension cord directly at the end of the material hose so that the operator can react immediately to avoid that the material gets under pressure.

Material to be used

- Injection mortar
- Cement paste
- Cement suspension
- Aqueous solution
- Machine usable jointing mortar
- Sealing slurries
- Fine filler
- Thick coating bitumen
- Lime cement plaster

No. 13577



Delivery control



After pumping operation, it is recommended to wash immediately the pump, the pipes and fittings with plenty of water and make a spherical sponge with suitable diameter pass through pipes and fittings.

Perform this operation as soon as possible to prevent grout from hardening.



ATTENTION: Before beginning to pump the injection grout, make flow in the pump some liquid concrete (prepared by mixing cement R32,5 with water) to prevent the rubber fittings to absorb the water in the mixture hardening the grout and clogging the channels. In order to be sure that the grout flows properly in the pump and fittings it is recommended to place the nozzle inside the filling tank of the pump and let the liquid concrete keep flowing until you are ready with the mixed grout.





E5. OPERATING INSTRUCTIONS FOR GROUT MIXING

In order to obtain a fluid, homogeneous grout mixture, and with the correct characteristics, it must perform the following procedure:

 Pour 3.0 liters of clean water into a clean bucket. Use the water doser to make the measurement correctly. Pay particular attention to the quality of the water used; it is suggested to use drinking water.

ATTENTION: The temperature for using the mixture is between **+ 5** ° **C** and **+ 35** ° **C**. Therefore, if the mixing operation is performed at low temperature it is recommended to use lukewarm water, instead if it is performed with high temperatures it is recommended to use cold water.

 Add the content of one bag in the buckle with water and mix with the drill mixer for about two minutes. Add the content slowly by a continuous flux.





Remove from the buckle walls the possible accumulation of dust not yet mixed.

If the batch is not very fluid or too thick for the injection operations, it is suggested to add more water up to a maximum of **0.4 liters**. The addition of this further quantity of water is needed especially when the mixing operation takes place at high temperatures. Before proceeding with the addition of this water, perform the flow table test as shown in the next paragraph E6.



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ABSOLUTE PROHIBITION: in order to prevent a loss of strength and delay of maturation timing, it is absolutely prohibited to exceed the water quantity prescribed in the former paragraphs.

 Allow the fluid mixture to stand for a couple of minutes, taking care of removing all the mixture from the container edges by using a putty knife or trowel.



- Stir the mixture again for another 2 to 3 minutes making sure that it is homogenous and free of lumps and build ups.

ATTENTION: Pour and / or inject the liquid mixture immediately; its processability lasts about one hour at a temperature of + 20 ° C, this time can drastically be reduced with very hot, dry weather.

MANDATORY: Before you start filling up the sleeves, make sure that all the liquid concrete, as mentioned at p.56, gets out from the injection tubes, discarding the first part of the grout leaking from the pump.

ATTENTION: Always keep the pump running in order to keep the mixture stirring and moving even if the injection operation would suffer from a break. To do this, simply insert in the loading tank, the injection terminal, and let the mixture flow (As shown in the circulation phase of the liquid concrete).





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E6. FLOW TABLE TEST

Before starting the filling operations perform the flow table test with the mixture prepared in the first bucket.

This test, **MANDATORY**, is needed to assess the correct amount of water used. The diameter after spreading of the grout should be between 300mm and 330mm.

If the spreading is less than 300mm, add some water to the mixture, stir it and re-do the test. However, it is not allowed to exceed 3,4 liters of water per each powder bag.

If the spreading is greater than 330 mm, it must throw away the mixture just prepared and arrange a new grout bag using a lower amount of water.

In order to perform correctly the test you must have:

- A clean glass plate and not smaller than 350 × 350mm placed on a flat surface;

- A meter with millimeter scale;

- A metal frustum-shaped ring in accordance with the EN 7044/72 (size equal to \emptyset inf = 100mm, \emptyset sup = 70mm and height 60mm).





The initial fluidity control takes place according to the procedure inspired to UNI 7044/72 but excluding the application of shocks (considered the high fluidity of the mixture), according to the method reported below.



- Fill in the frustum-shaped container supported at the center of the glass plate with the mixture just prepared.



- Stop the filling when the grout has reached the edge of the frustum-shaped container.





- Slowly lift and clean the frustum-shaped container so that a negligible amount of mixture remains.



- Let the mixture expand until it doesn't stop its motion.





> One minute after the lifting, check the spreading of the mixture along two orthogonal diameters.



- Recover the mixture;
- Clean the table and frustum-shaped container.

CAUTION: Perform the test before the beginning of each casting phase or if during the same phase the weather or environmental conditions vary significantly.