



Constructive solutions

Method Statement:

Conbextra BB92

Guidance for the Grouting of Wind Tower Foundations

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1. Scope and Definition

- a. This method statement sets out the process for the correct application of Conbextra BB92, high performance grout when used on wind turbines. This process applies to grouting at the interface between the anchor cage foundation and turbine tower.
- b. Application of the grouts must be in accordance with the method given below in order to achieve the performance stated on the technical data sheet. Applicators must also read and adhere to instructions given in the corresponding technical data sheets.
- c. Each turbine manufacturer will have specific instructions for grouting. It is suggested that method statements are thoroughly examined and discrepancies discussed before commencement of grouting.
- d. Only trained and experienced applicators should use this material. Fosroc will, by agreement, provide technical surveys and applicator training.
- e. Fosroc must be notified, 5 working days prior to commencement, of any turbine grouting works using Conbextra BB92.
- f. Fosroc will not be responsible for liabilities that might arise regarding mis-application of these grouts.
- g. If any information contained within this document is unclear, please contact your local Fosroc technical department for clarification.

2. Health and Safety

- a. The materials and equipment described in this document should be used in accordance with the health & safety regulations of country of application.
- b. The most up-to-date safety data sheet should be read prior to handling materials.
- c. Site specific requirements shall be observed as dictated by the supervising contract administrator.
- d. Corresponding PPE and protection tools should be used.
- e. For Conbextra BB92, the following precautionary pictograms should be observed as a minimum safety requirement.



3. Equipment

- a. The contractor must ensure that the equipment on site is suitable, calibrated and in good working order.
- b. Wherever possible, spare equipment shall be on-hand for emergencies, especially in the time-critical process of product application.

3.1 Mixing and Pumping Equipment for 25kg Bags

- a. Mixer
- b. Pump
- c. Hoses & spares
- d. Lifting platform (if pumping at height is required)
- e. Water meter
- f. Sufficient equipment capacity shall be provided by the contractor to ensure that the Conbextra BB92 can be mixed and placed in the allotted time. Two mixers may be necessary. The contractor shall make provision that all grout required for the specific anchor cage can be mixed & placed within a maximum of 150 minutes and the works planned to be completed in 1 to 2 hours thereafter.
- g. Hose of 50mm internal Ø is recommended. The hose shall be of sufficient length to run from a fixed position of the mixer to reach around the entire circumference of the tower.
- h. Application may be undertaken with two pumps simultaneously.
- i. We recommend equipment that has a double function of mixing & pumping. An example of this type is the Putzmeister S5 EVTm (see specification in section 12).



3.2 Test equipment for product control at site

- a. Prism moulds 40mm x 40mm x 160mm or cubes 40mm, 50mm or 70mm to measure compressive and flexural strength. Moulds must be metal.

- b. Flow cone: ASTM C230 or EN1015-3 or Fosroc Brass cone (90mm height)
- c. Level, non-porous surface on which to measure fluidity.
- d. Stopwatch
- e. Thermometer: laser, digital or red liquid
- f. Spatulas
- g. Jug for sample taking
- h. Ruler or tape measure

3.3 Work Equipment

- a. Water tanks
- b. Tubs, buckets
- c. Expanded polystyrene strips (e.g. Policord)
- d. Formwork (as dictated by contract requirements)
- e. Sheaths for bolts
- f. Polythene sheet (for curing in hot or windy conditions)
- g. Thermal blanket (heating) or hessian sack (for cooling)
- h. Jet washer (for cleaning of equipment)
- i. Tools: float, brush, knife



4. Storage and Transport Instructions

- a. Conbextra BB92 bags require careful storage & handling to maintain physical properties. This helps achieve a high quality end product.
- b. Storage of Conbextra powder must be in the original sealed container under dry conditions. Protect from rain, condensation, high humidity, frost & direct sunlight. The recommended storage temperature is between 5°C and 35°C.
- c. Grouts are sensitive to moisture. If kept dry, their properties remain unchanged. Relative humidity must be kept to a minimum in the warehouse.
- d. Bags of grout should not be stored on wet ground or floors. Keep on insulated pallets above ground, to prevent the grout absorbing moisture.

- e. The warehouse roof should be pitched and water tight to prevent ingress of water; no cracks or openings on ceilings or walls. The storage floor should be dry & sound.
- f. The bags should be stacked together to reduce airflow, but never stacked against external walls (a gap of around 30cm is recommended).
- g. Stacked no greater than two pallets high (to prevent material compaction)
- h. Bags should be covered with a waterproof sheet.
- i. Bags should be stored and used following the first in first out system (FIFO).
- j. When the grout is to be used, it must arrive at the mixer in the original, sealed packaging and remain so until it is used. Never mix half-used or open bags.
- k. Bags of grouts sufficient only for that day's consumption should be taken from storage. They should be placed on an insulated base, above well drained land. If rain occurs or is likely, they must be covered with waterproof sheets.
- l. Any bags with lumps or cured material must be discarded. They must not be part mixed or sieved.

5. Weather Conditions

5.1 Climate Considerations, Limitations for Application

- a. The applicator & contract supervisor shall take into consideration the forecast weather conditions prior to application of Conbextra BB92.
- b. Accurate site records must be maintained recording site specific weather conditions, including minimum & maximum temperatures.
- c. Fosroc does not recommend application of Conbextra BB92 outside the temperature range stated in the technical data sheet (5°C to 35°C). However it is recognised that on exceptional occasions, extreme weather working cannot be avoided. If work is to progress at temperatures outside those stated on the data sheet the site contract administrator must be informed and Fosroc's Technical Department should be consulted. Compromise may be undertaken only under agreement by all parties & after a full risk assessment. It is vital that these guidelines are followed.
- d. When recording temperature, the following checks should be included:
 - surfaces in contact with the grout
 - air
 - material
 - water

5.2 Hot Climates

- a. Apply the grout early in the morning or late at night, when conditions are coolest.
- b. Ensure the foundation, equipment, powder and water remain cool, protecting with awnings, bags of ice, damp cloths, etc.
- c. Upper temperature limit advised is 35°C for formwork & substrate, air and grout.
- d. If close to the upper limit, soak the substrate with cold water to reduce the temperature (remove excess water before grouting commences). Use cold water and mix with powder that has been pre-conditioned below 25°C. Decreasing the temperature of the mixed material helps prevent loss of fluidity. Check temperature with a laser thermometer.
- e. Wet the exterior of the hoses, to keep them cool.
- f. In hot conditions shorter working times will be experienced than those stated on the Technical Data sheet.

5.3 Cold Climates

- a. Beware of falling temperatures.
- b. Where possible, tent and heat the application area. Pre-heat powders and mixing water before commencing work. Use warm water for pre-soaking the substrate (remove excess water before grouting commences).
- c. The substrate must be free of ice.
- d. Ideally the product should be applied at an ambient temperature of 5°C or above. Application can commence between 2°C and 5°C only if the temperature is rising. Never apply below 2°C
- e. Use mixing water ~ 50°C to raise the temperature of the mixed material.
- f. Use frost blankets to protect the material after application.
- g. Note in cold conditions physical properties such as strength will be slower to develop than those stated on the data sheet.

5.4 Climates with a High Rainfall or Humidity

- a. Keep the bags dry in storage and when transporting to site (see Section 4).
- b. The working area should be sheltered from rain immediately before, during and for 24 hours after application of the grout.
- c. Avoid contact with rainwater during application. Protect the bags, equipment and substrate from the rain.

- d. Remove freestanding water from hoses and substrate. Standing surface water will lead to de-bonded / weaker areas beneath the baseplate.
- e. Do not allow rainwater to enter the mixing vessel as this will alter the water / powder ratio, increasing fluidity of the grout, reducing strengths and potentially causing segregation. Careful flow & segregation testing is recommended.

6. Foundation Preparation

6.1 Concrete Surface

- a. It is advised to dampen the support at least 24 hours prior to applying the grout. Surface should be saturated surface dry. This prevents unwanted absorption of water from the grout and consequential drying shrinkage cracks.
- b. Before pumping, ensure that the concrete surface is free from oil, grease, soil and slurry by high pressure water jetting. The jetting will also dampen and roughen the concrete surface. This ensures full adhesion of the grout.
- c. The concrete surface can also be prepared by mechanical means to produce a rough surface. In this case, post cleaning, the concrete surface should also be saturated with water.
- d. Prior to any grouting works the anchor cage pipes should be taped and sealed following the instructions of the site contracts administrator. Check these are in good condition.
- e. All the water to be used in contact with the concrete, whether jetting, saturating the support or mixing of the grout, shall meet the requirements of EN1008; it is highly recommended to use drinking water.
- f. Remove any contaminated / excess water from the surface of the concrete prior to applying the grout.



6.2 Flange

- a. A self-adhesive expanded polystyrene strip is placed on the lower edge of the flange, both inside and out.
- b. Its function is to form an expansion joint between the flange and the grout and also to mark the highest point the grout should reach; do not exceed this height.



6.3 Formwork

- a. It must be correctly positioned; secure and able to resist the pressure it must bear. It must be sealed at the bottom to avoid grout leakage.
- b. The permitted types of formwork are metal or phenolic ply-board. The surface must be clean, smooth and non-absorbent.
- c. A suitable Auramol release agent must be used (e.g. Auramol H15). Take care not to spill onto the substrate.



6.4 Bolts

- a. Direct contact between grout and bolts underneath the flange is not permitted. To prevent occurrence, fit a protective sheath around the bolt.
- b. Before grouting check that sheaths are correctly set and have not been damaged by site works.



6.5 Buffer

- a. Fit a cross plate or buffer between the formwork, to use as a marker for the start and end of the grout application.



7. Grouting Process

7.1 Hose Preparation

- a. It is essential to lubricate the hoses and equipment prior to each phase of grouting. This should be done with a water and cement slurry, at a w/c ratio between 0.40 and 0.45. Alternatively Conbextra Primer (ex Fosroc Spain) may be used.

- b. The lubrication should be completely flushed through with grout, to ensure the lubrication does not enter the formwork.

7.2 Mixing Process 25kg bag

- a. Four operators are required to undertake the mixing & pumping process. Two to be in charge of mixing: the first to oversee the mixing time and the amount of water added, the second to add the powder to the mixer. Two operators are required to handle the placement of the product and control of the hoses.
- b. Avoid having to move the equipment after mixing has commenced. At the outset, plan the position & reach of the hoses, other machinery and supplies.
- c. The quantity of grout per batch to be mixed will depend on the mixer's capacity. As a guide, for a mixer with a capacity of 150 litres, the ideal quantity of grout per batch would be 4 bags (100 kg).
- d. Full bags should always be used; check the condition of the bags and expiry dates, before adding to the mixer.
- e. For good process control, place the quantity of material to be used per mix (e.g. 4 x 25kg bags) in lots corresponding to each batch.
- f. Measure the mixing water precisely.
- g. In cold or temperate weather use 11 litres of water per 100 kg of Conbextra BB92. In warm weather the amount of water required is 12 litres.
- h. Add the water to the mixer, start the mixer and then gradually add the powder. Once all the bags have been added, begin timing. After 2-3 minutes stop the mixer and scrape the vessel sides & bottom to ensure there is no dry or unmixed powder. Continue mixing for a further 2-3 minutes. Ensure total product homogenisation.
- i. Note. If the mixer has a bottom port, beware of possible water loss. To prevent leakage it may be necessary to add one bag of powder to the mixer first, begin the mixer, then add the water, followed by the remainder of powder.
- j. During early mixing the grout may appear dry; do not add more water than the stated amount. After 2-3 minutes the mix will wet-out.
- k. Note the time to achieve a homogenous mix can vary and will depend on factors such as power rating of the mixer, blade rpm and material temperature.
- l. Once mixed transfer the grout to the pump hopper and then re-circulate the through the first section of hose back into the hopper. At this point make the required QC as stated in **Section 9** and any other QC instructions that are in place from the contract administrator.

- m. During the QC testing and recirculation process, the next batch is prepared, as described above.
- n. If the QC flow tests do not meet specification or if segregation occurs, do not proceed with the application.
- o. When the QC is complete & correct and the second mix is ready, commence placement of the grout.

7.3 Grout Placement

- a. Placement of the grout should be in one continuous application, maintaining a continuous flow of grout.
- b. Ensure that the pumping speed is consistent and suitable for the amount of grout to be placed and allows for proper mixing of the required subsequent batches.
- c. Place the stinger (rigid end of hose) at the bottom of the grout trough in its centre in order to reduce the amount of blowholes on the top surface.
- d. The stinger should be shifted around the circumference of the tower to avoid overflow and to minimise the need for the grout to travel long distances, which may result in material segregation. However, the stinger should not be continuously moved, usually grouting from 4 separate points will be sufficient.
- e. The working life for placing the grout is typically 150 mins at 20°C, (consult most recent Technical Data Sheet). It is advisable to place the grout without unnecessary delay after mixing & QC, the recommendation is placement should typically be completed in 1 to 2 hours, where practically possible.
- f. The grout has a sufficiently long open time, providing placement is continuous, that allows for completion of the application before material begins to set. New grout must never be placed on top of the existing material; the stinger must always be placed at the bottom.
- g. Do not vibrate or agitate the grout after placement.

8. Curing

- a. The purpose of a controlled grout cure is to prevent cracking from rapid water loss. Curing is particularly important in warm climates and in the presence of wind.
- b. The curing process should start immediately after grout application.
- c. There are several methods of curing. Note water curing is permissible; however the contractor must ensure that water levels are maintained adequately and that an accurate record is kept of this process.

8.1 Standard Conditions

- a. Apply a suitable Fosroc curing agent e.g. Concure S (Fosroc Spain) or Concure WB (Fosroc UK), according to data sheet instructions.
- b. As the turbine will be situated in areas of high wind, it is important to apply the curing agent as soon as possible after completion of grouting and then wrap to protect further, preventing grout desiccation.

8.2 High Temperatures

- a. Spray-apply a Fosroc curing agent according to data sheet instructions.
- b. Additionally protect the grout with secured polythene or wet hessian for 48 hours immediately after its application. Ensure the hessian remains damp during that period.
- c. After 48 hours, the grout will be sufficiently cured to allow for the polythene or hessian to be removed.



8.3 Low Temperatures

- a. Spray-apply a suitable Fosroc curing agent according to data sheet instructions.
- b. If the ambient temperature is or predicted to fall below 5°C, protect the grout by shrouding with heated tents. Alternatively use thermal (heated) blankets.
- c. The grout should be protected from the cold for at least 48 hours immediately after application.

9. Testing

- a. Site testing shall be done to the satisfaction of the contract administrator. Accurate records of site conditions, material batch numbers and product performance tests should be maintained during the contract.
- b. The frequency and content of the quality control testing shall be agreed by all parties prior to the commencement of the contract. Fosroc recommends that QC testing takes place on each turbine foundation and if a new batch of Conbextra BB92 is used.
- c. The site logs provided by the contracts administrator shall be the primary source for site quality control, although other tests may be required as directed by the contract administrator.

9.1 Flow Test

- a. Conduct flow tests in an area protected from wind, direct sunlight and other environmental factors that may affect flow.
- b. The sample is tested for flow using either a EN1015-3 cone, Fosroc Brass Cone (90mm height) or ASTM C230 cone to determine whether the grout has the specified fluidity and that there is no segregation.
- c. The fluidity of the grout prior to application should within the parameters stated in the technical data sheet.
- d. If the flow value is out of specification or segregation occurs, do not use the grout.
- e. If the batch passes, it may be used for compressive strength testing.

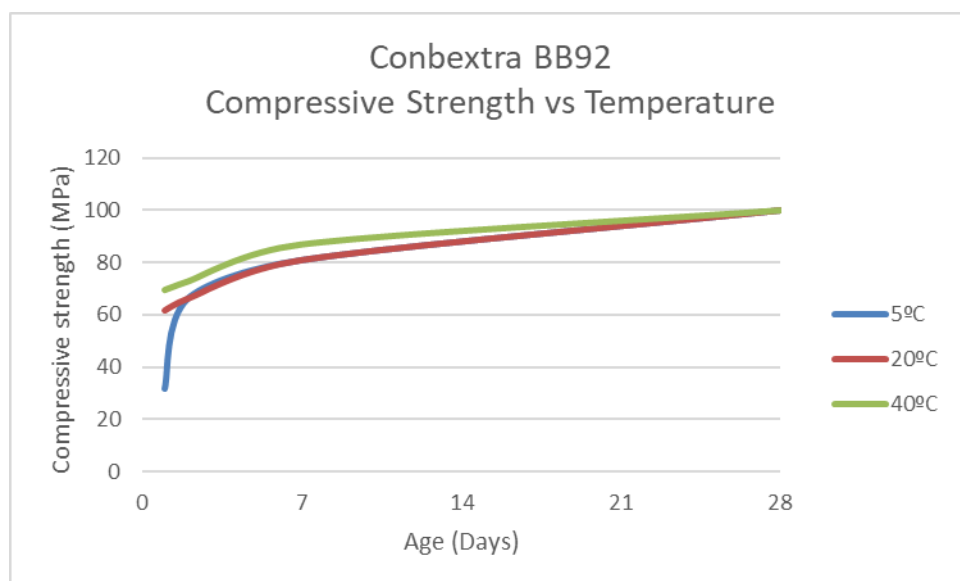
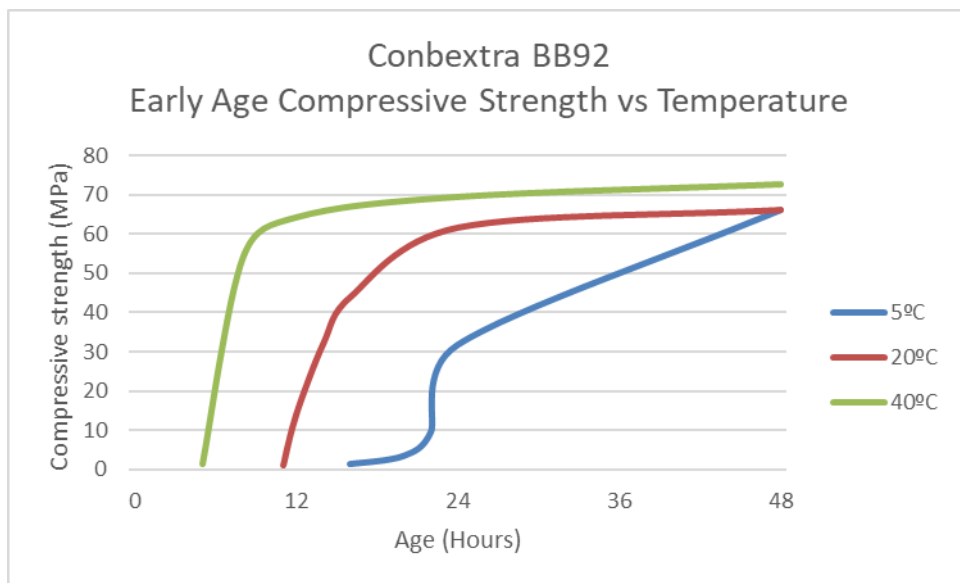


9.2 Compressive Strength Test

- a. Prior to bolt tensioning, the grout compressive strength must be determined.
- b. The number of cubes to be cast is determined contract administrator, normally this will be twelve per turbine, but can vary on instruction by the administrator.
- c. Moulds must be metal and within the tolerances set out in the standard. Discard any mould that is damaged, pitted or no longer square. It is not permissible to use plastic moulds.
- d. Mould dimensions should be agreed with the contract administrator prior to commencement of the contract.
- e. The cubes shall be treated with mould release oil and once cast shall be restrained.
- f. The moulds must not be vibrated; a gentle tap to the sides to release trapped air is permissible.
- g. The moulds should be kept on site for 24 hours, protected from the environment restrained and temperature controlled as per the cast foundation grout.
- h. After 24 hours the moulds can be removed from site and stored as stated in the standard.



- i. Typically three specimens will be crushed after 1, 3 and 28 days or as specified by the site administrator. The last three cubes are spares in case of issues with the former.
- j. Records of the results shall be forwarded to the contract administrator, including the mode of cube failure, age, weight, conditioning regime.
- k. Given below are example grout compressive strength tables and curves at varying ages and temperatures.



9.3 Fresh Wet Density Test

- a. Follow the methodology of EN 12350:2019, testing the fresh wet density of the grout once it has been mixed and passed through the pump. This to help ensure e.g. correct ratio of water: powder, no air entrained or segregated material
- b. The container should be metal and free-standing. The volume should be known and calibrated, ideally between 1litre and 500ml.
- c. Weigh the container and record the mass, or tare the scales to zero value.
- d. Fill the container with grout, remove any overfill with a straight-edge, clean any spillages. Do not vibrate or compact the grout.
- e. Fresh wet density shall be calculated by dividing the mass of the grout (minus the container mass) by the volume of the container. Record the fresh wet density, time, date, temperature and water / powder ratio.



10. Quality Control and Site Records

- a. Keeping accurate records of site details is important to the smooth running and maintenance of quality throughout the application of the materials. This is the sole responsibility of the application specialist.
- b. Deviations from the accepted norms must be agreed with all parties involved in the contract.
- c. The site records shall be recorded in accordance with the contract administrator's requirements . Fosroc can provide a guide template.

11. Repairing Cracks and Damage

- a. After curing (minimum of 28 days after application), check the surface appearance for cracks, cavities and adherence to the support.

11.1 Surface Micro-Cracks

- a. Determine first the type of crack; the majority (but not all) are likely to be surface cracks
- b. Seal with a suitable Fosroc repair product e.g. Nitocote CM660 Putty (Fosroc Spain) or Renderoc ST05 or Renderoc FC (Fosroc UK). Apply as per the data sheet.

- c. After sealing any cracks, it is advisable to cover the exposed grout surface with a protective coating e.g. Dekguard WF10 (Fosroc Spain) or Dekguard E2000 (Fosroc UK).

11.2 Significant Cracks

- a. Larger / deeper cracks must be repaired by injecting a low viscosity resins e.g. Nitokit LV (Fosroc UK) or Nitoprime 50 (Fosroc Spain); this procedure should be performed by trained operators. See Table in Appendix.

11.3 Surface Gaps and Cavities

- a. Larger surface holes (lack of grout), must be repaired. Different products are available depending on the size of the gap; contact the Local Fosroc OpCo Technical Helpline.

11.4 Substrate to Grout Adhesion Failure

- a. If there has been an adhesion failure to the substrate, consult with turbine manufacturer or appropriate delegated representative to reach a collaborative decision on remedial actions. One outcome may require the foundation to be demolished. Other options are to strengthen the bond between the grout and base concrete using the method for injecting low viscosity resins, as specified in point 11.2 and the corresponding annex.

12. Referenced Documents

- a. Conbextra BB92 SDS
- b. Conbextra BB92 TDS
- c. Fosroc Procedure for Applicator Approval
- d. BS EN 1504-6:2006. Products and systems for the protection and repair of concrete structures. Definitions, requirements, quality control and evaluation of conformity. Anchoring of reinforcing steel bar
- e. ASTM C230/C230M - 14. Standard Specification for Flow Table for Use in Tests of Hydraulic Cement.
- f. BS EN 1015-3:1999. Methods of test for mortar for masonry. Determination of consistence of fresh mortar (by flow table)
- g. BS EN 13395-2:2002. Products and systems for the protection and repair of concrete structures. Test methods. Determination of workability. Test for flow of grout or mortar
- h. BS EN 12390-3:2019. Testing hardened concrete. Compressive strength of test specimens
- i. BS EN 12390-6:2009. Testing hardened concrete. Tensile splitting strength of test specimens
- j. BS EN 12190:1999. Products and systems for the protection and repair of concrete structures. Test methods. Determination of compressive strength of repair mortar.
- k. BS EN 12350-2:2019. Testing fresh concrete. Slump test.
- l. [Link PutzmeisterS5](#)
- m. Fosroc Brass Cone dimensions

End of Method Statement (*Ref UK v1 March 2020*)

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